# Developing a Mobile Application Prototype for a Tutoring Enterprise by way of Feature Investigation

## NL Nilsson
## 28585828

ITRI 671 Mini Dissertation submitted for the degree *Baccalaureus Scientiae Honours* in Information Technology and Computer Science in at the North-West University

Supervisor:            Mr. L Bunt

Date of submission:        30 November 2020

Version:   1.1

# ABSTRACT

A primary and secondary school tutoring enterprise in Vanderbijlpark, South Africa have been experiencing a decrease in efficiency and accuracy service because employees spend most of their valuable time completing tiresome administrative and scheduling tasks. They are in a dire need for a solution that will ease the weight of the employees' tasks and thus increase the efficiency and accuracy of the enterprise. To help the enterprise, a mobile application with the required features and functions was modelled to automate the administrative and scheduling tasks that the employees perform so that the employees do not waste their precious time on these tedious tasks. Previous literature lacks information about features and functions that are required for administrative applications in an educational setting. This study investigated the features and functions that are required by users for an administrative application, these features and functions were used to inform the development of the mobile application. Participants are employees at the tutoring enterprise. Structured individual interviews were used to gather data from the participants in the study. The data was then analysed using content analysis and open coding to reveal the information that was needed before the mobile application could be designed. It was concluded that participants requested functions concerned with automation of attendance recording, statement generation and class scheduling. The participants also desired features such as role-based access control and the ability to log in before any changes are made. Furthermore, the participants felt that the use of a mobile can benefit and disadvantage the enterprise somewhat. It was also determined that the participants prefer any Android device as a suitable platform for the application. The mobile application was designed with those functions and features as a foundation for what the application should do and include.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# CHAPTER I: INTRODUCTION

## 1.1    Introduction

The following study investigated the features and functions required by users that then aided in the development of a mobile application to automate administrative and scheduling tasks at a tutoring enterprise in Vanderbijlpark, South Africa. The tasks at the tutoring enterprise are paper-based and time-consuming. The staff struggle to keep up enterprise standards because they do not have enough time or staff to complete these tasks. Moreover, they lack software that can make their tasks easier to complete. A mobile application was modelled to benefit the enterprise and remove the various shortcomings that were identified. Before the application was designed, it was critical to understand what features and functionalities were desired by the enterprise in question.

The aim of the study was set out and explained in order to realise the applicable objectives. Once the aim was determined, the researcher established the research approach and methodologies that were followed. Participants formed a vital part of this study and therefore a suitable group of participants was chosen. Furthermore, the inclusion criteria of these participants were explained. Data was collected and analysed that answered the research questions that were outlined in this chapter. The data collection methods were clearly defined, and the data analysis was explained in detail. Data obtained from participants was analysed accurately and transparently.

Throughout the study, predetermined and foundational ethical considerations were always adhered to. Most of the ethical considerations were aimed towards the participants—since no person should have been disadvantaged by this study. Before proceeding with the study, it is necessary to understand the context and investigate existing information relevant to the research.

## 1.2    Background to study

The tutoring enterprise this study is based on, lacks software capable of streamlining and technologising their administrative- and scheduling tasks. The processes involved in scheduling classes and administrative tasks remain largely analogue and paper-based in a world enthralled by promises of the fourth industrial revolution. Such an environment has various benefits, such as being more comprehensive and can be more accurate since changes can be made easily and there are no software rules to stop the user from writing information on paper (Noyes and Garland, 2008).  One disadvantage of a print-only environment is that all logical calculations must be done manually. Another disadvantage is that tasks take longer to complete on paper, whereas it can be performed through technological means in seconds. The paper-based environment also requires an effective filing system and if paper sources are not stored correctly it can cause

miscommunication between individuals, and other organisational issues (conflict, mismanagement, etc.).

Paper-based tasks typically take longer to perform than digitally based ones. This leads to more time spent completing tasks than focussing on the quality of service (Ter Hofstede *et al.*, 2009:3). To make this business more productive, various scheduling processes and administrative tasks were automated from a paper-based environment to a technological environment (by modelling a mobile application). The use of mobile applications for administrative tasks in a business environment is steadily growing, as it increased by 98% in 2018 (Andre, 2020;Varshney *et al.*, 2000). According to Nah *et al.* (2005), benefits of mobile applications include that they can make a business more effective, increase communication throughout the enterprise and lead to a more productive environment where employees store and access information faster (Nah *et al.*, 2005).

In a study conducted to test whether mobile applications are a viable option for completing administrative tasks, it was concluded that mobile applications are a good option if the features and functions of the application fit with the tasks that have to be performed by the business (Gebauer and Shaw, 2002). According to Goodwin (1987), users will not make use of an application if its functions do not fit their requirements. Therefore, it is important to understand what features and functions this application should have to make it suitable for the business that this study is based on.

## 1.3    Problem statement

The world is increasingly becoming technology-driven and having to manually perform administration tasks takes up vital time and effort (Kampas, 2003). A primary and secondary tutoring enterprise in Vanderbijlpark currently schedules classes by hand with a paper-based filling/scheduling system. These tasks are therefore tedious and time-consuming. Other administration tasks are also completed manually and result in mistakes and poor service due to time/human constraints. Some of these tasks include to generate invoice statements for the students and to keep record of the attendance of students. The student's attendance is used to calculate their statement. Recording the attendance incorrectly, will result in the statement being calculated incorrectly. This incorrect statement is sent to the client and mistakes on the statements then upset the client.

The enterprise desperately needs a solution that will help the employees save time and reduce the risk of mistakes and miscalculations. The tasks performed by the staff can be automated in and augmented by an application. Automating these processes by developing application can increase the state of the enterprise, by allowing staff to focus on more customer related tasks rather than time-consuming administrative duties (Ter Hofstede *et al.*, 2009). The tasks that are

performed by the enterprise are the functions that should be included in the application. For this reason, it is important to investigate which features and functionalities are needed in the proposed application, so the manual efforts of staff are decreased and optimistically, optimised.

Questions related to this study include:
- *What benefits would the development of an application pose to the enterprise?*
- *What platform should the application be developed on?*
- *What features and functions are desired by the users to be able to do their administrative tasks more effectively?*

## 1.4    Key concepts of the study

### 1.4.1   Features

Features are described as many things and there is no *fixed* definition for a feature that accurately describes each scenario in which it can be used (AlSubaihin, 2016). The Merriam-Webster online dictionary defines a 'feature' as a "prominent part or aspect of something" (Merriam-Webster, 2020b). The *features* of a mobile application help the user choose the most effective application for their needs, and therefore features are the most important factor of a mobile application (Chen *et al.*, 2019). Typical features requested by users for an administrative application will be examined in Chapter III: Literature Review.

### 1.4.2   Functionalities

*Functions* are significant aspects that must be included to be useful for someone (Goodwin, 1987). According to Merriam-Webster (2020c), functionality is the "state of being functional" and a function is the reason why certain things exist (Merriam-Webster, 2020c). A news application should have the function to broadcast the latest news. If a news application cannot broadcast the news, it is useless to a person who wants the news.

### 1.4.3   Mobile Application

A mobile application is software created to perform a certain function on various portable, handheld devices that can be used almost anywhere at any time (Islam *et al.*, 2010). There are various types of mobile applications, functionality wise, and there is also various development paradigms that can be applied to mobile applications (Poetker, 2019; Que *et al.*, 2016). The type of app describes what the application will be used for, this can be for social interaction, playing games, entertainment, and more (Islam *et al.*, 2010; Poetker, 2019).

The development paradigms describe what platform(s) the application can be used on and includes (Que *et al.*, 2016):

- **Native applications**: developed for a specific platform.
- **Hybrid applications**: developed to work on various platforms and must be downloaded from an application store on the device.
- **Web applications**: a browser-based application that requires an internet connection but can be used on almost any platform.

### 1.4.4  Automation

According to Merriam-Webster (2020a), *automation* is a manner of making a process, apparatus or system operate automatically. Automation does not always mean there is no human interaction, in some cases processes can operate semi-automatically where human interception is still needed (Säfsten *et al.*, 2007). The process of automation involves moving from a manual operated process to a process operated automatically by one or many technological device(s). This is related to the shift from paper-based to technology-based for the enterprise under consideration.

### 1.5  Research aim and objectives

The objectives and aims of the research are set out in the proceeding section. These research aims and objectives are important because they describe *why* the study will be done:

### 1.5.1  Research aim

This study aims to develop a mobile application prototype with relevant features and functions to automate the administrative and scheduling tasks of the enterprise that this study is based on. The mobile application then hopes to be timesaving for the employees and increase the efficiency and accuracy of the enterprise.

### 1.5.2  Research objectives

Objectives describe how the research aim will be reached by completing certain goals (Terrell, 2015). The research objective is divided into the primary objective and the secondary objective. The primary objective will focus on what should be done in the study, while the secondary objective will describe what should be done to achieve the primary objective.

### 1.5.3  Primary objective

The primary objective of this study is understand the desired features and functionalities by users that will be used in the prototype development of a mobile application to increase the overall performance at a primary and secondary tutoring enterprise; by automating class scheduling and

administrative tasks. Determining the features and functionalities users desire explains what the mobile should include to satisfy the users and ultimately solve their problem.

### 1.5.4 Secondary objectives

The secondary objectives will be used to achieve the primary objective through the study. Before the primary function can be completed, it is important to understand the factors included in it. The following are the objectives:

- Determine what devices will be best to use for the enterprise.
- Investigate what features and functionalities are required by the users for the application.
- Determine what benefits the administrative and scheduling mobile application present to the enterprise.

## 1.6 Research approach

The research approach of this study will be qualitative, requiring collection and analysis of open-ended data through sampling, questionnaires and interviews (Choy, 2014). This qualitative approach requires the researcher to understand the behaviours and actions of the business (Choy, 2014). According to Choy (2014), a qualitative approach has many advantages. One includes the underlying values, beliefs and assumptions of the participants can be studied and the outcome of the study can change according to these. The main disadvantage of using a qualitative approach is that analysis of data is time-consuming. For this study, an action design science methodology will be used alongside the qualitative research approach. Combining the action design science methodology and qualitative approach will allow the researcher to determine if the application is appropriate for the business from the users' viewpoint.

### 1.6.1 Research methodology

A design science methodology coupled with action research will be used for this study. Problems that require new technology (i.e. software, device etc.) can be solved using design science. Design science leads to the improvement of an aspect by designing, developing, instantiating, and evaluating a certain artefact which can be in the form of a concept, prototype, procedure, or principle (Baskerville *et al.*, 2009). In the design phase, all requirements of the users are investigated and set out as factors that must be included in the artefact. Once the design of the artefact is complete, the actual development of the artefact can begin. This is where the appropriate development tools must be used, and the fundamental requirements must be developed first. Once the artefact reaches a certain point of completion, it can be tested by the user and evaluated. This process is repeated until specific requirements are met as seen in Figure 1.6-a (Hevner, 2007).
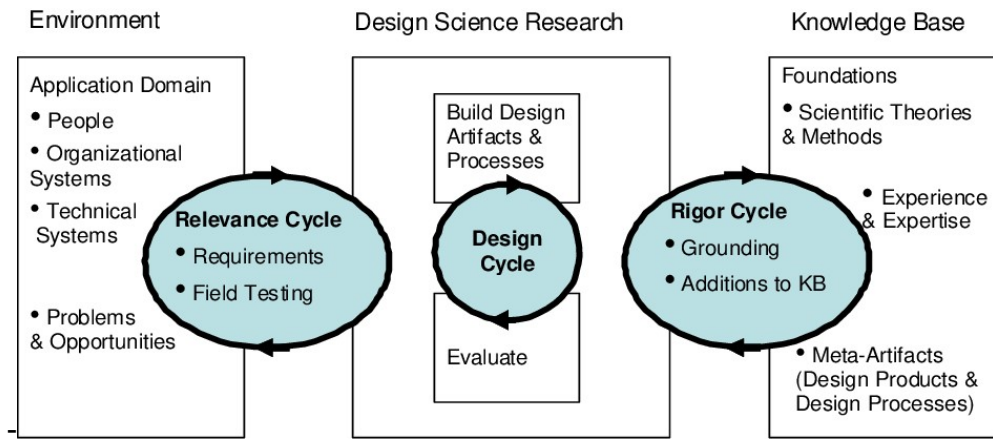
**Figure 1.6-a: Research Cycles of Design Science**

Action research also involves a continuous cycle that investigates problems systematically (Stringer, 2013). Action research is applied to find a unique solution to a problem for a certain group since a general solution might not solve the problem for all groups (Stringer, 2013). With action research the researcher co-operates with the group the study is based on, the researcher communicates and observes the participants while they are together in the environment (Koshy *et al.*, 2010). Coupling action research with design science research enables the researcher to develop an artefact that must solve a problem for a group (design science research) and then study the implications of this artefact in the actual environment of the group (action research) by co-operating with the group (Iivari and Venable, 2009). Action design science creates a direct relationship between the research results and the artefact that is being developed (MacColl *et al.*, 2005). This aspect of action design science is very valuable to this study since the data collected and analysed should result in information, such as the desired features and functions, that will be used when the mobile application is developed.

### 1.6.2 Selection of participants

Participants in this study will be tutors employed at the primary and secondary tutoring enterprise in Vanderbijlpark. Participation will be completely voluntary, and participants can refuse participation in the study. The owner of the enterprise will be interviewed to determine what the requirements of the application are and what rules should be applied regarding employee access—such as what changes employees should be able to make. Employees will also be interviewed to determine what features and functionalities they consider important and how the application can be user friendly for them. All employees (tutors or administrative staff) will be allowed to volunteer as participants since the study specifically requires their input. Since the business is diminutive, the sample size of the participants is expected to be four or five and input from the participants will be required until data saturation is reached. Input from the participants are crucial since they are be the users that will use the mobile application on a daily basis.

### 1.6.3 Data collection and analysis

As mentioned earlier, the data gathered and analysed is used in the designing of the mobile application. Conclusions made from the analysed data determine if the objectives of the study are reached. Accordingly, suitable data collection and analysis methods must be chosen.

### 1.6.3.1 Data collection method

Qualitative data is collected in this study since the perceptions, thoughts and opinions of the participants are needed for feature investigation. The participants opinions are important because they are the end-users of the mobile application and they expect the application to perform certain functions and contain certain features that they need. This qualitative data can be collected with several instruments such as interviews, questionnaires, or sampling (Choy, 2014:102).

In this study, data was collected with personal interviews. Interviews allow the researcher to gain a more acute and valuable understanding of the data (Gill *et al.*, 2008:292). Interviews can be formatted in a structured, semi-structured, or unstructured manner and the researcher must choose the format that they think will gather the most useful and credible data (Choy, 2014:211). A structured personal interview will be conducted with the office employees and/or the tutors of the tutoring enterprise before the application is developed. The interview will be used to gather information about what the requirements for the application are.

### 1.6.3.2 Data analysis

The goal of the data analysis is to identify key elements in the data (Silverman, 2013). Once the main elements are identified, the link between these main elements should be examined (Silverman, 2013). In this study, content analysis with open coding is used to analyse data. According to Thomas (2003) and Elo and Kyngäs (2008), the process of content analysis consists of three phases and a total of eight steps, which are:

- Preparation phase
    - Step 1: Select a unit of analysis, this can be a key word, sentence of whole body of text. This is used as a foundation by which the data will be analysed accordingly.
    - Step 2: Closely read the text to get a better understanding of the content and details. The reader should get a clear picture of what the data means and should be able to answer questions like Who? What? When? Where? and Why?.

- Organising phase
  - Step 3: Write headings and notes about the data.
  - Step 4: Write the headings and notes on coding sheets and group them casually. Text that contain the same theme or information are grouped together. Some categories can be more general while others can be more specific.
  - Step 5: Make groups with all the headings where the headings are similar. Headings that do not fit in are written separately and named with a descriptive heading.
  - Step 6: This step is like step 5 except that the groups are categorized according to groups that describe the same topics or concepts.
  - Step 7: In this step the categories that were made in the previous step, are named and described to gain an understanding of what each category contains.
- Reporting phase
  - Step 8: This is the final step in content analysis and requires the researcher to draw conclusions from the categorised data that hopefully answers the research questions and meets the objectives of the study.

Doing data analysis correctly is very important since the information gathered from data analysis will be used in the design and development of the artefact. The conclusions drawn from data analysis will also tell the researcher if the objectives of the study have been reached.

## 1.7   Ethical considerations

The study must follow the North-West University's ethical guideline to meet ethical requirements. According to Greaney *et al.* (2012), three key principles exist when a research is conducted. These include:

### 1.7.1   Respect

It is important for the researcher to respect the participants to prevent exploitation of them. There are key ethical rules that must be followed to ensure the participants are respected (Greaney *et al.*, 2012). These rules are:

- Information about participants must be confidential and researchers must ensure that confidentiality and anonymity is maintained.
- The participant must give written consent to be part of the study.
- Participants must be allowed to have enough time to fully review the artefact and must be allowed to give their honest opinion without external influence.

### 1.7.2  Beneficence

Researched should ensure the participants' wellbeing by maximising the benefits they receive from the study and minimise the harm it could cause (Greaney *et al.*, 2012). The following must be done to ensure that the participants gain from the study:

- Perform risk assessments to identify any factors that might influence the study negatively.
- The participant must be aware of the reason for the study and what role they will fulfil in the study.

### 1.7.3  Justice

It is important that the researcher should examine if the participant will benefit from the study and if they are suitable participants (Greaney *et al.*, 2012). Some studies require the researcher to omit or incorporate certain groups. Some key points to look at would be:

- Do not exclude individuals because they are minority or vulnerable groups. If a group is excluded, there should be a good reason for doing so.
- It should be possible to access the participants if they are needed for information.

## 1.8  Conclusion

This study aims to develop a mobile application with various features and functionalities that are required to automate scheduling and administrative processes at a tutoring enterprise in South Africa. Features and functionalities are important in an application since the application will be of no benefit is it does not fit the needs of the user. This study utilises a qualitative approach and will also employ a design science methodology to collect data. Action research will also be exercised, as the outcome of the study is to emancipate the employees at the target business. Participants of the study will include employees at the enterprise who volunteer to be part of the study. Interviews will be used to gather data and the data will then be analysed with content analysis and open coding. An application will be developed with the desired features and functionalities obtained from the interviews with the enterprise's employees. The proceeding chapter will explain the research plan that was followed during the study.

# CHAPTER II: RESEARCH PLAN

## 2.1    Introduction

The research process starts when an individual discovers a gap in industry or literature and consists of many phases, including: establishing the goal of the study, defining the research questions and objectives, choosing a relevant research design, and collecting/analysing data according to the chosen paradigm and methodology (Bell *et al.*, 2018:4). The aim of this study is to develop a mobile application prototype with the most sought-after features to automate various scheduling and administrative tasks at a primary and secondary school tutoring enterprise in Vanderbijlpark, South Africa.

The research process plays an important role in this study and determining the correct research design and following steps within the research process is crucial for completing the most important parts of the research (Avgousti, 2013:34). The research design will establish the research paradigm and methodology to be utilised and the "research onion" (put forward by Saunders *et al.*, 2011) will be used to visually represent the research design. For this study, a qualitative research approach will be used since the participants' opinions and experiences are to be examined. Choosing the correct research method will avoid problems that may arise when undertaking the research (Bell, 2014:9). Finally, an action design research methodology will be used since an application will be developed to emancipate and support the enterprise in question.

The development of an application requires research to collection and analyse data from various participants that require the artefact/intervention. While research is conducted and there are participants in the study, all ethical considerations should be noted and complied to as well. Moreover, it is also important to note what limitations exist for this study and how to overcome them. The research plan will form a framework to be followed by the researcher in this study. Before the research plan can be established, the goal of the study along with the research questions and objectives will be stated.

## 2.2    Research questions and objectives

The primary goal of this study is to develop a mobile application prototype after the desired features of the target user base has been determined. This application is envisioned to automate various scheduling and administrative tasks for the enterprise in the study. Moreover, it is argued by Chen *et al.* (2019) that the arising application must have certain features and functionalities for it to be useful. The problem statement for the study is that employees at the tutoring enterprise spend most of their time doing tedious and time-consuming administrative tasks; and felt the need for a solution that would save time and increase the performance of the enterprise.

The following research questions are put forward for this study:

1. What benefits would the development of an application pose to the enterprise?
2. What device should the application be developed for?
3. What features and functionalities are desired by the users to be able to do their administrative tasks more effectively?

To ensure that the research questions are answered, certain objectives are set in place. The foremost objective is to gather participant feedback about what features and functions they feel should be included in the mobile application aims to automate scheduling- and administrative tasks. Various secondary objectives have also been identified to achieve the primary objective. These objectives are as follows:

- Determine the possible benefits that the enterprise might experience from an administrative and scheduling mobile application.
- Determine what device would be most suitable for the enterprise.
- Investigate the features and functions that are desired by the users for the mobile application.

## 2.3   Research design

Firstly, the research design provides a framework for the study and describes what approaches will be used in the study (Sileyew, 2019). Secondly, this describes what information is relevant to the study and what processes will be followed to reach the research objectives (Sileyew, 2019). A good way to understand the research design to be followed in this study is to use the research onion for visual representation. The figure below shows the research onion, which can be used to set out the whole research design.
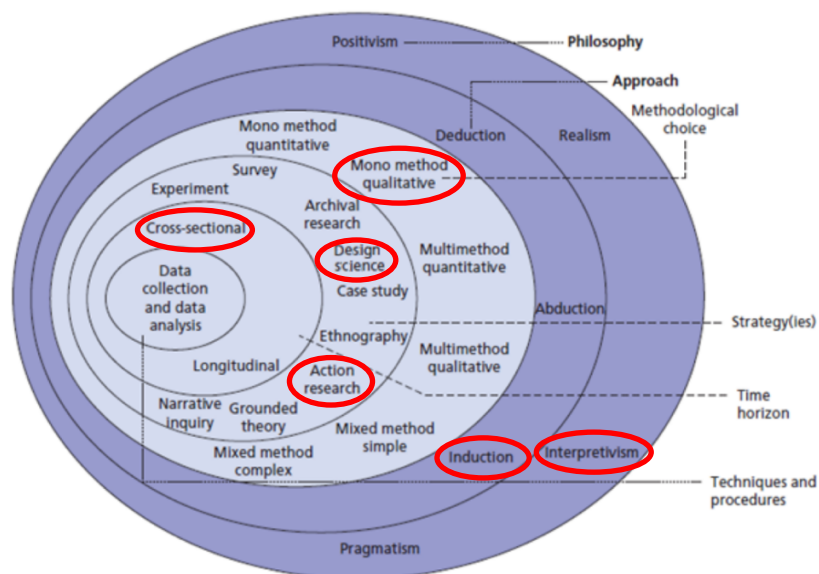


**Figure 2.3-a: The Research Onion. Adapted from (Saunders *et al.*, 2011).**

The layers of the research onion are used by starting at the outer layer and going through each layer until the middle layer is reached. The philosophy for this study is interpretivism; since the study considers the emotions, opinions, and perceptions of the participants. Induction will be used for the research approach—describing the methodological choice that will be followed—mono method, qualitative research. The mono method qualitative methodological choice is used since only a single method of data collection is used and the data is derived from participants' perceptions and personal experiences. In terms of strategy, the design science research, coupled with action research, will be used since an artefact will be conceptualised for this study and the artefact must solve a problem for a specific group in a unique setting. The time horizon for this study is cross-sectional since the perceptions of the participants in current time will be considered, and not the long-term perceptions of the participants. With all these layers of the research onion, the data collection and analysis can be done in a way that will satisfy the aim of the study. The data collection method includes personal interviews with the participants and the data will be analysed with content analysis using open coding. The research paradigm and methodology will be described in the section below.

### 2.3.1 Research paradigm

A research paradigm forms the overarching framework and theoretical perspective for a study (Pickton, 2013). Furthermore, this paradigm is the set of beliefs the researcher uses to guide their action(s), and are subject to change over time (Creswell and Poth, 2016). The research paradigm can be quantitative, qualitative or both depending on the type of data the researcher will collect (Johnson and Onwuegbuzie, 2004). Each of these paradigms can be used in certain scenarios. For this study, the qualitative research paradigm will be used.

Qualitative research has various definitions, and there is no one definition that is used by all authors or researchers (Creswell and Poth, 2016). One definition by Denzin and Lincoln (2011) state that qualitative research is an interpretive practice that makes the world visible to the researcher in a way so they can study things in their natural setting and interpret people's experiences, as they perceive them. Another definition is that qualitative research is based on exploration, discovery and theory generation and uses data that is based on participants' experiences and attitudes (Johnson and Onwuegbuzie, 2004; McCusker and Gunaydin, 2015). Both definitions point out that people's perceptions have high priority within qualitative research. It is therefore necessary to collect and analyse data in a way that allows the participants and/or people in the study to voice their own opinions, experiences, and meanings. Data collected and analysed with the qualitative research method is open-ended and gathered by using research instruments such as sampling, questionnaires and interviews (Choy, 2014).

As mentioned earlier, each paradigm can be used in certain scenarios and using the wrong research paradigm can lead to unsatisfied objectives (Silverman, 2013). According to Silverman (2013), qualitative research may not always be appropriate for a research topic. Table 2.3-a below shows various topics for which qualitative research would be suitable.

**Table 2.3-a: Suitable topics for qualitative research. Adapted from (Silverman, 2013)**

| Situations where qualitative research is suitable. |
| --- |
| - Understand social interaction in real-life situations such as meetings and social media. |
| - Understand how people perceive experiences or respond to situations. |
| - Understand various processes such as teaching a class or managing a business. |
| - Study complex and/or sensitive issues in depth for example violence or drug use. |

According to Creswell and Poth (2016), qualitative research is needed to explore a problem that has been identified. This problem must be understood in a detailed manner.

Qualitative research can be used in the following scenarios (Creswell and Poth, 2016):

- Situations where data must be collected by talking to people in their natural setting where they can explain their experiences that would not usually be found in literature.

- For scenarios where people's opinions, stories and concerns are encouraged without promoting a power relationship between the researcher and participants.

- Scenarios where the setting or nature of the participants should be understood to understand a problem better.

- Qualitative research can follow up quantitative research, quantitative research can be used to detect trends and qualitative research can then be used to describe why the trend occurs.

- To develop various theories for specific populations or group of people where existing theories only partially exist or theories that do not address complex problems.

- Use qualitative research when quantitative research cannot be used, and the data cannot be represented in any statistical or numerical manner.

In this study the experiences of the participants will be considered, as it is necessary to understand the administrative processes of the enterprise. The problem that has been identified are specific to the employees of the enterprise and no existing software exists for the enterprise to use. These actions match the topics that Silverman (2013) and Creswell and Poth (2016) state as suitable for qualitative research. For this reason, the qualitative research method will be utilised for this study.

### 2.3.2 Research methodology

According to Bell *et al.* (2018), the researcher should be able to answer the research questions using the chosen qualitative research method. For this study, it is important to choose a suitable method that would support the development of an application. As such, an action design science methodology coupling will be used.

Design science is applied to investigate and design an artefact that can solve a problem or improve an existing artefact (Wieringa, 2014). According to Wieringa (2014), an artefact in itself cannot always solve the problem, but the problem is solved when users interact with the artefact. Design science is an iterative process that mainly requires designing and building the artefact and evaluating the impact of the artefact (Weber, 2010) on a working context. The artefact developed can be software, logic for deductive reasoning, mathematical rigor, descriptions in natural language and more (Hevner *et al.*, 2004). The design science methodology will be coupled with action research.

Action research, similar to design science, is an iterative process that is used to combine theory and practice (Avison *et al.*, 1999). The biggest advantage of action research is that it forms a relationship between the research and the practice, research can be used to inform the practice and vice versa (Avison *et al.*, 1999). This means that information can be gathered directly from the participants who the study is based on and research that is done can be evaluated in the setting where the participants are. According to Tacchi *et al.* (2003), action research consists of two steps. The first step involves analysis in collaboration with the participants and formulating a theory. The second step is to implement a change and study the results. By using action research, the solution is created for a very specific problem identified within a unique group.

Action design research combines design science and action research (Mullarkey and Hevner, 2019). Design science is followed to create an artefact that solves a problem and action research allows the researcher to work together with the participants/group that the study is based on (MacColl *et al.*, 2005). Action design research is used to link the research findings back to the artefact that will be developed, and it requires constant interaction between the researcher and the participants. Action design research will be used in this study since the researcher is required to solve a specific problem for a unique group. The artefact will be developed and adjusted with regular feedback and information from the participants. The action design research methodology is suitable for this study since an artefact—in the form of an application prototype—will be developed with information gathered from the population or group to solve a problem for that certain population or group. The process used in action design research involves planning, doing, observing and reflecting (MacColl *et al.*, 2005). This process analogous to the design science research process.

14

Design science research has a process that researchers follow to carry out their research (Peffers *et al.*, 2007). This design science process serves as a commonly accepted framework and it consists of six activities that are iterative (Peffers *et al.*, 2007). Figure 2.3-b graphically describes the design science process as six clearly defined activities. These activities are performed in a cyclical manner to improve the artefact until the problem has been solved.
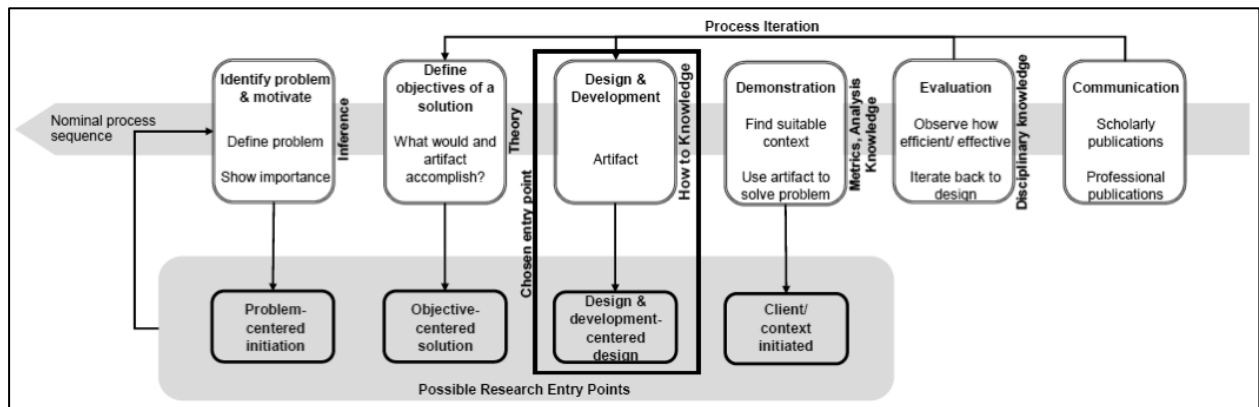


**Figure 2.3-b : Model for the Design Science Research Methodology Process. Adapted from (Peffers *et al.*, 2007).**

The activities in the design science process:

Activity 1: Problem Identification and Motivation

Define the research problem that has been identified and explain why the solution is important. The definition of the problem will be used to develop an artefact and therefore it is important to break up the problem so that the complexity of the solution can be captured. Stating the importance of the solution, moreover, can motivate the researcher and audience to find a resolution and it can explain what the researcher understands about the problem to the audience.

Activity 2: Define objectives

The objectives for the solution must be derived from the problem definition and they must be possible. The objectives can be qualitative or quantitative. Knowledge of the problem and other similar problems can be used to derive objectives.

Activity 3: Design & develop the artefact

This can be seen as the core of design science and in some instances the focus is more on various discrete activities of design and development where as in other instance the focus is more on the iterative process (Peffers *et al.*, 2007). The artefact is created during this activity. Various activities within this domain include determining the functionality and the architecture of the artefact and creating the actual artefact.

Activity 4: Demonstrate

For this activity, the use of the artefact should be demonstrated to solve the problem that has been identified to improve the use in experimentation, simulation, or other activities. For this activity, the efficiency and effectiveness of the artefact can be tested.

Activity 5: Evaluate

The artefact must be observed and measured on how well it solves the problem by matching the objectives set out for the solution to the results obtained from the use of the artefact in the demonstration activity. Evaluation can be done in many ways depending on the artefact and the setting it will be used in. The functionalities of the artefact can be compared with the research objectives that were determined, quantitative measures, satisfaction surveys from users, feedback, or simulations. After evaluation is done the researcher must decide whether to cycle back to the third activity and upgrade the artefact or to move on to the next activity and postpone improvements for later projects.

Activity 6: Communicate.

In this activity the summary of the other activities are communicated, including the identified problem and why it is important, the artefact (along with its use and uniqueness), the accuracy of the design, and the performance of the artefact to researchers and/or other audiences. For scholarly research publications, the communication forms part of the empirical work that will be done (Peffers *et al.*, 2007).

This process is structured in a sequential order from activity one through to activity six, however, according to Peffers *et al.* (2007), it cannot be expected that all researchers will follow the process sequentially; and it is possible for the researcher to start at almost any step and move forward. There are four possible research entry points. These establish the problem-centred approach: (a) which starts at activity one, (b) the objective-centred approach which starts at activity two, (c) the design & development-centred approach which starts at activity three, and (d) the client or context initiated approach which starts at activity four.

The design science research process acts as a framework to follow. By following this process, the researcher is capable of solving a predetermined problem, satisfying the objectives of the study and answering research questions (Peffers *et al.*, 2007). However, this does not ensure that research rigour and even with a framework, the researcher is not guaranteed to solve the problem in an optimal manner. Hevner *et al.* (2004) establish seven guidelines to conduct and evaluate design-science research to determine if research rigour is ensured. The guidelines are derived from the one important principle of design science.

The principle as stated by Hevner *et al.* (2004) is that 'knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact'.

The seven guidelines are discussed below (Hevner *et al.*, 2004):

Guideline 1: Design as an Artefact

The research must deliver an artefact that is feasible in the form of a concept, prototype, procedure, or a principle.

Guideline 2: Relevance of the Problem

The objectives of the research include the development of technology-based solutions to a relevant problem.

Guideline 3: Design Evaluation

The benefits, quality, and effectiveness of the artefact must be demonstrated with well-executed evaluation methods.

Guideline 4: Research Contributions

The contributions that were made in the design artefact, design foundations and design methodologies should be provided.

Guideline 5: Research Rigor

Apply methods and/or processes in the construction and evaluation of the artefact rigorously to ensure optimal solutions.

Guideline 6: Use Design as a Search Mechanism

To search for an effective artefact, it is important to use available means to reach the desired solution while complying to ethics in the study.

Guideline 7: Communication of Research

Present the artefact to technology, as well as management-oriented audiences in an effective manner.

Hevner *et al.* (2004) states that it is necessary to use these guidelines when applying the design science methodology for a study. These guidelines are adaptive and can be changed to fit the study appropriately. In this study, particularly, the design science research process steps discussed will be used and the guidelines set out by Hevner *et al.* (2004) will be used to evaluate the research with regards to the design science methodology. The entry point for the research is design and development-centered approach as indicated on

Figure 2.**3-b** and the first activity that will be focused on is activity three; which is the design and development of the artefact. According to Peffers *et al.* (2007), the design & development-centered approach can be used when there is an existing artefact but has not been considered to be a solution. When a similar artefact might have come from another research domain, or the artefact is an analogical idea for an existing process or artefact. The reason why the entry point for this study is design & development-centered is because the artefact appears as an analogical idea for the system that is currently in place at the tutoring enterprise; but there is no existing artefact to solve the problem that has been identified. Moreover, feedback from the tutoring enterprise will be acquired before the concept of the artefact is compiled. Therefore, it is not necessary to design and develop an artefact from the beginning with no awareness of what is needed to satisfy the objectives and iterate the process until the objectives are satisfied. Due to time constraints, the design science process will only be iterated once and more cycles for improvement will be left for later research studies if it is needed and possible. For the research design to be used effectively, data must be collected and analysed. Data plays a very important role in research since it will be used to theory building and evaluation, the data will also be used to measure if the aim of the study has been reached (Weber, 2010).

## 2.4 Data collection

Data collection includes gathering and measuring information that is suitable to the situation in such a way that it can be used to address a certain research problem or answer research questions, test a hypotheses and evaluate the outcome. There are various methods for data collection for various types of research, but the accurate and honest collection of data should always be ensured (Kabir, 2016). The goal of data collection is to gather quality evidence that can be analysed and used to build a convincing and credible answer to research questions (Kabir, 2016).

There are steps that can be followed when collecting data (Bhandari, 2020;Kabir, 2016):

Step 1: Determine the type of data that will be collected

This can include qualitative, quantitative, or mixed method data.

<u>Step 2: Choose the data collection instrument</u>

According to Kabir (2016), there are many methods to collect qualitative data, including questionnaires, interviews (individual or focus group), observation, survey, case-studies and diary entries.

<u>Step 3: Plan the data collection procedures</u>

This includes planning what procedures will be undertaken to ensure the data needed will be retrieved. For example, for an interview it is necessary to plan what questions will be asked to participants.

<u>Step 4: Determine the participants of the study</u>

Also known as sampling, it is important to determine who will form part of the data collection group and why those specific participants are chosen.

<u>Step 5: Collect the data</u>

In this step the researcher collects the data from the relevant sources with the chosen data collection instrument. If qualitative will be collected from participants or other people, it is important to record the session.

For this study, qualitative data will be collected since that is the best form of information for the study. The data collection method for this study is the use of individual, online interviews. Each participant will partake in one interview. Individual interviews allow the researcher to ask questions and receive answers from the participants. Each participant answers the questions from their own perspectives. The interview will be constructed with knowledge attained from the literature review; with regards to what questions should be asked. This data collected from this interview is important since the data will be used to conceptualise the design of the artefact. As described in the research methodology, the design science research process will start at the artefact design and development activity since the interview with the participants will be conducted beforehand to establish what is needed for the artefact. The participants for this study include tutors and staff at the primary and secondary tutoring enterprise in question. These participants are chosen since the artefact will be developed for this specific enterprise and it will be used by the employees at the enterprise and therefor it is important to collect their perceptions and opinions. The participants can be accessed at the location of tutoring enterprise and the interviews will also be conducted there within the current governmental laws regarding the global COVID-19 pandemic.

Step 6: Create the interview

## 2.5   Data analysis

The process of data analysis starts after the data has been collected with the chosen instrument. Data analysis is used to identify key elements from the collected data. A link between these key elements is then examined and presented (Silverman, 2013). Data analysis can be time consuming with qualitative data, since the researcher is required to read through the data and understand what is meant by it (Johnson and Onwuegbuzie, 2004).

For this study, content analysis will be utilised to analyse the data. Content analysis can be undertaken for either quantitative or qualitative data and it can also be used in an inductive or deductive manner, in this study it will be used in a qualitative inductive manner (Elo and Kyngäs, 2008). According to Elo and Kyngäs (2008), content analysis consists of three phases and eight steps in total. A visual representation of the process can be seen in Figure 2.5-a:
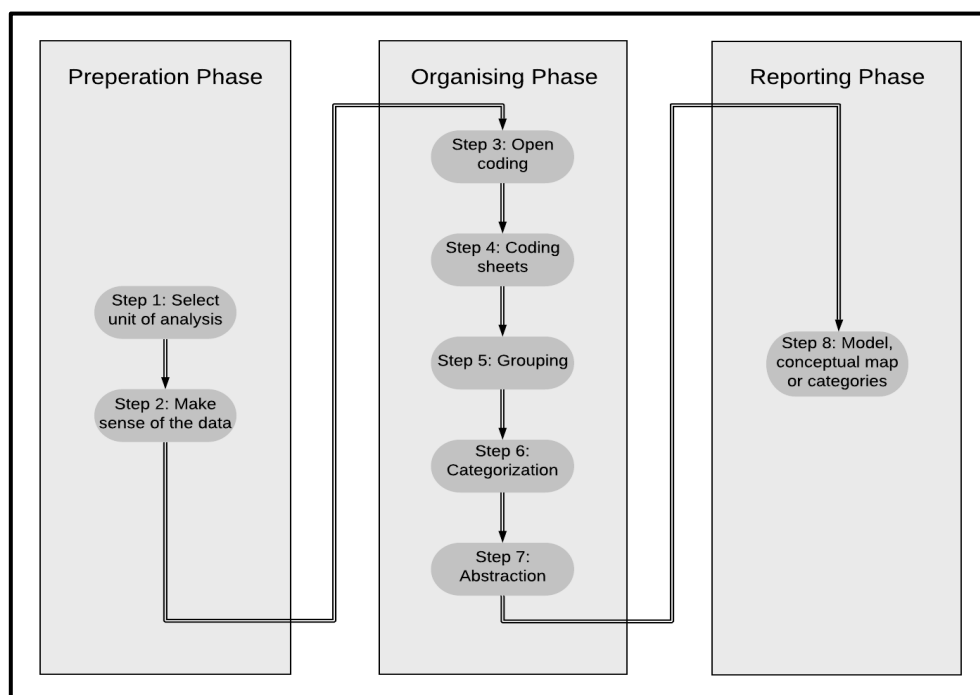


**Figure 2.5-a : Steps in Content Analysis. Derived from (Elo and Kyngäs, 2008)**

The first phase of content analysis involves preparatory activities and is comprised of the first two steps in the practice. The phase starts with selecting a unit for analysis. This can be a theme, key word, or concept. Depending on the size of the data, the unit can be a word, a sentence, or the entire interview. The next step is for the researcher to understand the data and make sense of it. According to Elo and Kyngäs (2008), some key questions to ask in this step include the 5W's; *Who? What? Where? When?* and *Why?*.

Analysis then moves to the organising phase, which includes open coding, categorising data, and abstraction (Elo and Kyngäs, 2008). The first step in the organising phase—open coding—

requires the researcher to take notes and write headings as the data is read. This step is repeated to ensure all the applicable data is acknowledged. These headings are then collected and written to coding sheets and informally categorised in step four. Once step four is complete, the list of categories is grouped to reduce the number of categories; by combining those that are similar and giving new headings to those that are contradictory. Although step five and step six seem similar in name, step six includes providing a way to describe the occurrence in order to increase understanding and generate knowledge (Cavanagh, 1997). Abstraction includes formulating a description of the research topic by making categories that are named using content-descriptive words. After step seven is finished, the reporting phase can begin. The reporting phase only has one step, which is describing the results as a model, conceptual map, or categories. After the analysis process is finished a report should be written with sufficient detail so that readers understand what process was followed for analysis and what the strengths and weaknesses of the process are (Elo and Kyngäs, 2008).

## 2.6 Ethics

The study must follow the North-West University's ethical guidelines to meet "good practice" ethical requirements. Various ethical considerations are available for the design science methodology. Although there are many more ethical principles exist than those that will be discussed, Myers and Venable (2014) states that having some ethical principles are better than none. The table below shows some ethical considerations that will be followed while conducting this design science study.

**Table 2.6-a: Ethical research principles**

| Ethical Principle | Description |
| --- | --- |
| 1. Respect | The researcher should ensure that all participants remain anonymous and their personal information should not be exploited. |
| 2. Beneficence | This requires the researcher to ensure that the participants will be safe, and that the artifact will not harm them. The researcher should also inform all participants of the reason for the study. |
| 3. Justice | Researchers should not be bias towards any groups of people. They should not exclude individuals because they are minority or vulnerable. |

## 2.7    Limitations of the study

There are various limitations in this study, as listed below:

- The enterprise that this study is based on went through a restructuring process due to the COVID-19 pandemic. Consequently, the sample size of the participants was reduced. To overcome this, input from the participants will be required until data saturation has been reached.

- The use of content analysis and open coding for qualitative data analysis might yield different results if performed by another researcher, since qualitative data is focused on feelings, perceptions, and opinions. To overcome this, a future study can make use of some quantitative analysis methods along with quantitative analysis.

- Since the study is done for a postgraduate honours degree, there are strict time constraints that have to be adhered to. This resulted in some aspects of the study that was not fully executed such as the iteration of the design science process.

## 2.8    Proposed timeline

The figure below shows a proposed timeline that will be followed for the remainder of the study.
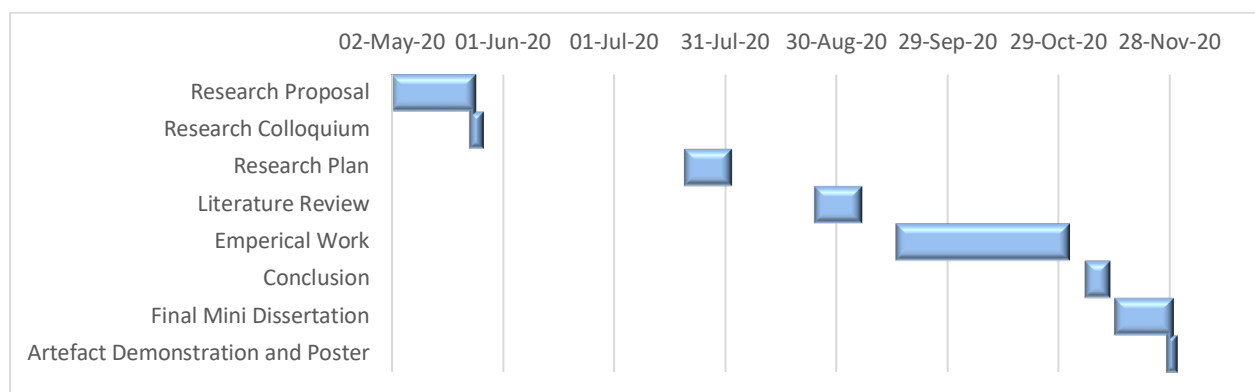


**Figure 2.8-a : Proposed Timeline Gantt Chart**

The proposed timeline describes what tasks need to be completed for a final mini dissertation. There are eight tasks starting from 2 May 2020 to 30 November 2020. The start dates and deadlines for each task is derived from the due date of each assignment represented as tasks. The tasks will be completed by doing research on that specific tasks and using guidelines. A complete description of each task can be seen in the table below.

**Table 2.8-a: Description of Timeline Tasks**

| Task 1<br>**Research Proposal** | Task 2<br>**Research Colloquium** | Task 3<br>**Research Plan** | Task 4<br>**Literature Review** |
|---|---|---|---|
| 2 May - 25 May | 23 May - 27 May | 20 July - 2 August | 24 August - 6 September |
| The purpose of the research proposal is to give an overview of the research problem, motivate the importance of the study and provide a preliminary research plan. | The research colloquium is a presentation of the research proposal to the audience. It can be a video or audio presentation highlighting the important aspects of the research proposal. | The research plan is a short document that explains the research approach that will be followed for the study. It should contain the proposed research and how it will be conducted. | The literature review contains a summary of previous research about a specific topic. It should describe, evaluate and clarify previous research. Through the literature review, the researcher should gain an understanding of similar research topics. |
| Completed | Completed | Completed | Upcoming |
| Task 5<br>**Emperical Work** | Task 6<br>**Conclusion** | Task 7<br>**Final Mini Dissertation** | Task 8<br>**Artefact Demonstration and Poster** |
| 15 September - 1 November | 5 November - 12 November | 13 November - 29 November | 27 November - 30 November |
| The emperical work involves documenting the results of the steps that were taken as set out in the research plan. Data collection and analysis form part of the emperical work. | The conclusion is a summary of all the previous tasks and explains how research objectives were met. The conclusion also includes contributions to- and limitations of the study. | The final mini dissertation is a complilation of all the previous tasks into one document. The tasks are added as chapters. All corrections and changes due to feedback should be reflected in this document. The artefact should be finished as well. | For this task the final artefact should be demonstrated along with a poster that accurately represents the artefact in an interesting and pleasing manner. |
| Upcoming | Upcoming | Upcoming | Upcoming |

This research plan is task 3, that was completed by 2 August 2020. The next task then started which is the Literature Review. The tasks will be completed sequentially meaning one task has to be finished before the next task can be finished.

## 2.9    Conclusion

The research plan forms a framework for the remainder of the study and expands the research process. The chosen research paradigm and methodology has been explored and any steps that should be followed where documented. The paradigm is the qualitative research paradigm and the methodology is the action design science methodology. The data collection method has been discussed and individual interviews will be used to gather data. Concept analysis will be used to analyse the data that has been collected. Various ethics that will be followed in the design science methodology was mentioned. There is one limitation for this study that is described along with a way to overcome this limitation.  A proposed timeline has been established and it is clear that the next part of the project is the literature review.

# CHAPTER III: LITERATURE REVIEW

## 3.1    Introduction

The goal of this study is to develop an event-based mobile application for a primary and secondary school tutoring enterprise; to automate their scheduling and administrative tasks. This is achieved by investigating what the most important features of the application should be. This chapter, then, will provide an overview of previous research and literature of related topics. A literature review has two primary purposes: firstly, for the researcher/reader to gain an understanding of the study's topic through study of previous literature on the topic; and secondly, to identify gaps in the literature to justify the study (Ashford Writing Center, 2020; Hart, 2018:1). Describing a research problem and the background of the problem can provide the reader with perspective of the literature and topics covered in it (Randolph, 2009:4). Central topics to focus on when reviewing and analysing literature should include the key concepts that are used in the study (Webster and Watson, 2002:xv;Winchester and Salji, 2016). Key concepts related to this literature review include automation, feature, tutoring, and mobile application(s). These key concepts will form part of the scope of the review and will be used to expound upon the significance of this study by identifying gaps found within the literature (Webster and Watson, 2002:xv). Before reviewing and analysing existing literature, the problem that has been identified will be stated and explained.

## 3.2    Overview of research problem

The tutoring enterprise this study is based on complete(s) their tasks by hand—using a paper-based system. These tasks include scheduling of classes and other administrative tasks (data capturing, filing, etc.). Classes are scheduled at the beginning of each month by an employee that also occupies a tutoring position at the enterprise. This requires the employees to schedule classes for each student for the month by looking at the times and dates the student is available, what classes they are taking, and what tutor will be able to help them (whilst documenting this information on paper). The administrative tasks include, but are not limited to, the processes followed by the enterprise. This process commences when the scheduling tasks are completed. The planned hours for each student are sent to the students' parents/guardians, as the student attends classes on the day and time assigned. Their attendance is then captured by the tutor and is also used to type and send an invoice to their parents/guardians in order to calculate the tutor's payment. The employees spend valuable time completing these tedious tasks rather than focusing on customer-related tasks, possibly leading to poor service. These tasks are vital to the operations of the enterprise and therefor the enterprise is in dire need of a faster, more effective system than a paper-based system.

## 3.3 Related literature

This study consists of three central topics that include (i) *tutoring enterprise environments*, (ii) *the use of mobile applications for business operation automation* and (iii) *feature investigation(s) for mobile application development*. These topics can be thoroughly explained when the key concepts of the study are understood since they form part of these topics (Webster and Watson, 2002:xv).

### 3.3.1 Key concepts

Key concepts will be explained to gain a better understanding of the topics that are central to the study. The key concepts related to these topics include *automation*, *feature(s)*, and *mobile application(s).*

### 3.3.1.1 Automation

Automation is the use of technology to accomplish tasks, processes, or procedures that were usually completed manually; meaning they are completed with no or very little human assistance (Bose *et al.*, 2012;Groover, 2016:75). Automation aims to enhance or replace human interaction, planning and problem solving with various types of technology—but it has been concluded that some systems still need human interaction (Bainbridge, 1983). The need for automation increases as processes become more complex, and as such, businesses want to streamline these processes (Bose *et al.*, 2012). There are many other reasons for automation other than streamlining complex processes, Groover (2016) provides nine (9) reasons that could motivate a business to automate processes:

1. Increase the productivity of the workforce;
2. Reduce the cost of labour;
3. Eradicate the problems cause by labour shortage;
4. Eliminate the manual labour in routine tasks;
5. Increase the safety of the workforce;
6. Improve the quality of the service of product;
7. Decrease the amount of time used for tasks;
8. Complete processes that manual labour cannot; and
9. Avoid the cost of not automating processes.

Furthermore, Bainbridge (1983) and Bose *et al.* (2012) state that automation can make the work of a human operator easier, lead to humans becoming better problem-solvers; since they have less time pressure. Moreover, Bainbridge (1983) concludes that once the easier tasks are automated, the human operator's work can become more difficult and humans can become more

ineffective when they are placed under time pressure. It is therefore important to automate the right processes so that it does not negatively influence the company in the end (Arntz *et al.*, 2017). Groover (2016) has determined that there are three components that can lead to effective automation of processes. The three components include (Groover, 2016):

1. Source of power

In most cases, some sort of technological device is used to accomplish automation and technological devices require a power source. This power source can include electric power, fossil fuels, atomic, sun-powered, water or wind energy. These power sources are used to drive the device.

2. Instructions

Instructions are used to define the actions that must be performed and can include one or many steps that must be followed in order to complete a process. These instructions are completed in a work cycle, meaning they start at one step and follow the next steps sequentially until the end is reached and then all the steps are repeated.

3. Control System

The control system is used to start the execution of the instructions that were defined. A control system receives some input and it then in turn starts a certain set of instructions based on the input.

Automation can thus be used in a great variety of situations. Arntz *et al.* (2017) found that automation can be used in tasks that include the exchange or selling of information, various handiwork, or routine tasks.

### 3.3.1.2 Feature(s)

There are several definitions for the term 'feature' and more than ten definitions can be found throughout literature (Apel and Kästner, 2009:2;Berger *et al.*, 2015). According to Apel and Kästner (2009:1), a feature can be described as a logical unit of functionality that meets certain requirements, represents decisions, or provides a specific arrangement option(s). Berger *et al.* (2015) conducted a study to determine what a feature is and concluded that the term feature changes depending on the situation in which it is used and that a feature consists of certain characteristics. These characteristics include that it should be able to represent a unique aspect of the software and should accurately define functionalities that are required by the customer (Berger *et al.*, 2015).

Features can be perceived in different ways. Berger *et al.* (2015) stated that features can be typical, good, bad, or outliers. Typical features are the main functionalities required or generally demanded by the customers. Outlier features are technical features that can indirectly solve a problem or meet a requirement. These features are mostly identified as features that influence the performance and it is not specifically requested or seen by the customer. A feature is considered good when it satisfies the customer, provides a unique functionality, is implemented in a good and useful manner and lastly free of any errors while bad features usually consist of features that where required by the user; but poorly implemented due to time pressure or rushed development.

While features are important to software development, promising customers more features than what is required can lead to a phenomena called "feature creep" (Jiang *et al.*, 2016). Feature creep exists when features are constantly added causing a product to become complex and not user-friendly (Harvey, 2016). When creating a product, system, or software only the required, core features should be added to avoid scope creep and inevitably upset the customer (Jiang *et al.*, 2016).

### 3.3.1.3 Tutoring

Tutoring is the method whereby a more knowledgeable person helps or teaches an individual or small group of students in addition to their daily class-based education (Cluey Learning, 2019;Medway, cited in Mischo and Haag, 2002;Wood *et al.*, 1976). The aim of tutoring is to increase the performance of the student while helping them acquire the learning skills they need to become an independent student. This is done by assisting students experiencing difficulties with homework, preparing students for upcoming examinations, and ensuring they obtain the knowledge required to successfully achieve the outcomes of their course/programme (Haag, cited in Mischo and Haag, 2002;Goetz, 2016). However, Goetz (2016) strongly feels that tutoring should not be used to complete a student's homework, but rather explain similar topics and allow the student to use their knowledge to complete the homework individually. Furthermore, the tutor should guide the student during a tutoring session.

The need for tutoring arises for five reasons. The first two reasons originate from the student while the remaining three originate from the student's educational institution (Mischo and Haag, 2002). The five reasons for the need of tutoring (Haag, cited in Mischo and Haag, 2002;Heinrich *et al.*, 2014):

- The student requires additional academic assistance;
- The student has difficulty studying through general practices;
- The student has a lack of quality education;

- The student has missed school lessons due to external factors; and
- The student's teachers are frequently changed.

There are various approaches to tutoring; and tutoring approaches differ from provider to provider (Zhang, 2019). Approaches to tutoring can be divided into three categories, including: (a) tutors, (b) modes of tutoring and (c) tutoring locations. Tutors can be students, retired or in-service teachers, professional tutors, self-employed instructors, volunteers, technological devices such as computers or employees at a tutoring enterprise (Mischo and Haag, 2002;Zhang, 2019). Modes of tutoring represent the manner in which tutoring is practiced and can include one-on-one classes, small groups, or large groups either online or in person (Cluey Learning, 2019; Mischo and Haag, 2002; Zhang, 2019). Lastly, the locations of tutoring can be at home, public places such as libraries, or learning/tutoring venues (Cluey Learning, 2019; Zhang, 2019).

### 3.3.1.4 Mobile Application

A mobile application is a piece of software that is developed for portable, hand-held devices that is user-friendly and accessible from almost any location—depending on the requirements of the application (Islam *et al.*, 2010; Karch, 2020). An application completes a certain task for a user. Moreover, the user can have more than one application for various tasks (Amalfitano *et al.*, 2013). Islam *et al.* (2010) and Poetker (2019) mention six main types of mobile applications that include:

1. Social Media Applications

These applications are used to communicate with other social media application users. Users can share images/videos/thoughts and have conversations with each other.

2. Game Applications

Game applications consist of games that can be played by users for entertainment. Game applications can be further divided into more categories to suit user preference. These applications can also be used individually, online with other players, or as a group where the device is shared among people.

3. Multimedia/Entertainment Applications

These applications can substitute for other entertainment devices or mediums such as televisions or books. The user can use an application to read a book, watch films or listen to music.

4. Productivity (including business and educational) Applications

Productivity applications can be used to achieve a certain goal, organise tasks, complete business operations, or communicate with other users in a professional manner. Each application is used for a single purpose to increase user experience.

5. Lifestyle Applications

Tasks including travel, exercise, or cuisine can be organised and planned in lifestyle applications. These applications keep track of personal information and activities to enhance user experience.

6. Utility Applications

These applications enhance the way the device is used by the user. Most of these applications are pre-installed on devices and gives the user access to information and a certain level of customisation.

According to Islam *et al.* (2010), mobile applications are not used solely for personal use but it has made a great impact in the business environment. Mobile applications can therefore be used in a business setting to complete certain tasks such as marketing, commerce, or operational processes (Islam *et al.*, 2010). The use of mobile applications continues to grow, requiring mobile application developers to constantly work on more effective software to ensure application quality and desirability (Amalfitano *et al.*, 2013).

### 3.3.2  Studies with similar central topics

The topics of tutoring enterprise environments, the use of mobile applications for business operation automation and feature investigation are central in this study. Each of the three main topics consist of at least one of the key concepts considered for the research. These topics will be used to research and analyse literature and delineate the boundaries of the study itself. The topic of tutoring enterprise environments is important when looking at related literature since this study is specifically focused on a tutoring enterprise. While mobile applications can be used for multiple purposes, it will not be designed and developed for the same purpose in all situations (Islam *et al.*, 2010). In this study, a mobile application will be used to automate administrative tasks. Therefore, another key topic to identify in literature is the use of mobile application(s) specifically for automation and completion of administrative tasks. There are many types of applications and each type of application can be developed differently depending on the requirements of the user (Islam *et al.*, 2010). The user's requirements are added as features in a mobile application (Apel and Kästner, 2009). The final topic that is crucial to find in related literature is the investigation of features—especially features needed in a mobile application that

aims to complete administrative tasks for a tutoring enterprise. Literature will be discussed in detail and the similarities between related literature and this study will also be mentioned.

### 3.3.2.1 Related study 1

In 2020, a study conducted by Lilljebjörn Rusk and Ejlertsson (2020) aimed to design and develop a mobile application to automate and increase the efficiency of administrative tasks performed by caregivers in healthcare. The use of a mobile application for business operation automation and feature/function investigation are applicable in Lilljebjörn Rusk and Ejlertsson's study. The case is similar to this particular study, since it aims to solve a problem for a business where employees need to perform tedious and time-consuming administrative tasks; and the chosen solution is to develop a mobile application with a certain set of features determined by conducting a pre-development interview (Lilljebjörn Rusk and Ejlertsson, 2020). Key differences can be found between the cases, however. Lilljebjörn Rusk and Ejlertsson's study is focused on the healthcare environment and not the tutoring environment. The businesses that Lilljebjörn Rusk and Ejlertsson's studied were equipped with an automated system, but these system(s) were not effective. There are also other administrative tasks that employees have to complete manually and they sought to automate these tasks with a new application (Lilljebjörn Rusk and Ejlertsson, 2020). Despite the differences, the methods used by Lilljebjörn Rusk and Ejlertsson can be useful to this study:

1. The establishment of needs

This includes data collection and analysis to determine the purpose and goal. Various participants can be used to collect data. The participants chosen for Lilljebjörn Rusk and Ejlertsson's study include employees from various wards at hospitals in Skåne that uses the existing system. Data was collected in a qualitative manner by interviewing participants and making observations. The interview contained questions regarding the participants' daily routines, administrative tasks that they had to complete and how these are done on the current system (Lilljebjörn Rusk and Ejlertsson, 2020). For data analysis Lilljebjörn Rusk and Ejlertsson used thematic analysis followed by formulation of goals.

2. Concept generation

Various concepts are created by using the data that was gathered. The concepts are evaluated, and the final concept is determined through this evaluation.

3. Prototyping

For this task, the conceptual design is used to develop a prototype of the application that users can interact with to some extent. The prototype is used to receive feedback and improve the application based on the feedback.

4. Evaluation

Once the prototype has been improved and no new feedback is received, the final design can be evaluated, and user tested. The design can thus be evaluated by receiving feedback from users that tested the design in various scenarios.

After the first task was completed, Lilljebjörn Rusk and Ejlertsson determined that there are 26 possible features/functions from which three are not necessary, twelve are necessary and will be implemented and eleven are merely desirable. The table below describes the 26 possible features/functions.

**Table 3.3-a: Function Investigation Evaluation (Lilljebjörn Rusk and Ejlertsson, 2020)**

| Not necessary | Necessary | Desirable |
|---|---|---|
| A function for patient wellness | Function 1: Easy access to more detailed patient information in a different view from the one with all patients | Combined view of patients being admitted to, and discharged from the same bed |
| Easier way of logging in to the app on the mobile device | Function 2: Being able to change view/layout based on which kind of information and how many patients the user wishes to see | A function to choose the amount of text or information the user wishes to see |
| Allowing any user to add new tags | Function 3: A handy mobile version with the same information as on the patient bed list | Integrating patient records with the mobile version to be able to access |
| | Function 4: Intuitive visual feedback when marking an examination as done | Adding optional examination/ tag packages when certain examinations always have other examinations/ tags associated with them |
| | Function 5: The mobile tool should be able to be used to update the system on other units. | Staffing information being visible for the same shift and sorted team wise |

| Not necessary | Necessary | Desirable |
|---|---|---|
| | Function 6: Display of the current care strain for the different teams with a function of being able to view the strain history | The information content of the mobile version should be based on the SBAR model |
| | Function 7: A notification should be received when a new patient is admitted to the ward that signifies that the patient must be assigned a staffing team and a bed | Having a free text field in the mobile tool where instructions or information can be added |
| | Function 8: Possible changed view of how to place the discharge date and exams | Built in function for calculating calorie intake and BMI in the mobile version |
| | Function 9: The mobile version's patient view should be able to be filtered and sorted by team | The mobile version should be individual and not require the user to log out each time the use of the mobile version is discontinued |
| | Function 10: A function where you can check off parts of a task such as controls taken several times a day | Messaging function between colleagues to alert them to tasks that need to be done |
| | Function 11: The mobile unit fits in the scrubs/ work outfits | Adding tasks to a specific date using a calendar function |
| | Function 12: Adding a bedding view as a complement to make the patient overview more intuitive to look at | |

### 3.3.2.2  Related study 2

Another study that shows correspondence is a study conducted by Ssempala *et al.* (2018), with the aim to develop a mobile application that can be used to automate academic school management tasks. This allows the core functionalities of the school to be accessible on a single platform. All the topics central to this study are related to the study in question. Although the study conducted by Ssempala *et al.* (2018) places focus on an academic school environment, it is closely related to this study since both studies are based on the educational sector. Ssempala *et al.* (2018) noticed that valuable time and labour is wasted by doing these tasks and through the development of an application with the correct features/functions can ease employees' workload (Ssempala *et al.*, 2018).

Ssempala *et al.* (2018) used system design as a method to conduct the study by firstly conceptualising the components of the system and then later moving to a physical design. System design consists of rigorous planning with the use of diagrams and one component is completed before working on the next component (Ssempala *et al.*, 2018). The solution proposed by the study is only applicable to secondary school grades and therefore participants in the study include employees at secondary schools, specifically at Makerere College School (Ssempala *et al.*, 2018). Ssempala *et al.* (2018) utilised four different data collection methods, including: literature review, bench marking, interviews, and observation.  The use of literature review and bench marking enabled Ssempala *et al.* (2018) to gain a better understanding of their topic; while interviews and observation provided qualitative data that will be used in the development of the application. The interview contained questions regarding the use of the current manual system and what the participant's opinion regarding the system are (Ssempala *et al.*, 2018). The collected data was analysed using critical analysis to identify various features/functions to be used as a guide when development of the application began (Ssempala *et al.*, 2018). The features/functions were divided into two categories, functions (necessary requirements) and features (desired requirements) and this allowed Ssempala *et al.* (2018) to focus on developing parts of the application that are necessary before developing nice-to-haves. The functions/features can be seen summarised in the table below:

**Table 3.3-b: Functions and Features Identified**

| Functions | Features |
|---|---|
| Register a student | User-friendly (easy to use) application |
| Record the attendance of students | Application that improves efficiency |
| Create a student ID | Bug-free and consistent application |
| Generate student report | Application must have a secure system |
| Generate a timeline | Application should have user validation during log in |

### 3.3.2.3  Related study 3

In a study conducted by Flora *et al.* (2014), various categories and features of mobile applications that users desire were investigated for different types of applications. The features were divided into three categories: Hardware, Software and Communication (Flora *et al.*, 2014). For this study, the software features will be investigated. According to Flora *et al.* (2014), determining the best features can lead to the development of a high quality mobile application since the features make the application useful and beneficial to users. There are many types of mobile applications and each type of application requires different features to make it desirable to users (Flora *et al.*, 2014). The study conducted by Flora *et al.* (2014) investigated general features of a mobile

application meaning features that should be included in all types of mobile applications. The features determined through survey in the study are summarized below (Flora *et al.*, 2014):

Good user experience

- Applications should be user-friendly, and users should be able to easily complete their tasks, this can be achieved by adding a quick tutorial.
- The application should start up quickly and be responsive immediately.

Good user interface

- The application should have a comfortable look-and-feel and a user interface that fits with the purpose of the application.
- Users should be able to navigate easily and there must be "Back" and "Exit" functions.
- The application should have a logical flow and the user must always know what to do next.

Flawless integration

- The application should be able to send and retrieve data quickly and this process must be flawless.
- The application's integration with other applications must be tested.

Valuable feedback

- Users must receive a notification of acknowledgement when an action is performed.
- Users must receive detailed and accurate alerts when errors occur.

Suitable focus

- The application must be focused on a central objective and simplistic.

Suitable for specified devices

- The application should fit with the style behaviour and requirements of the device it is installed on.

Continuous maintenance

- The application should be adjusted to work with any new device software developments and any issues should be fixed promptly.

Good responsiveness

- The application should always continue to be responsive and useable through long running operations.

Add personalization

- The user should be able to personalize the application for their individual usage preferences.
- The app should have role-based functions.

Location based information

- Information should be based on the location of the user such as local currency.

Always available and reachable

- Users should be able to use the application anywhere at any moment.
- Information should be accessible from anywhere.

Proper security

- Data that is transferred and sensitive information should be encrypted.
- The application should require a mobile certificate from clients that are used.
- Sessions must be disabled after being inactive for a certain period.
- Applications must contain measurements to monitor and prevent repeated requests from attackers.

This study will develop a mobile application to automate administrative tasks for a tutoring enterprise and thus consists of three central topics used for investigation of literature. This ensures that relevant literature can be found and used as a guide for this study, especially for the formulation of questions that can be asked to determine features applicable in this study. In both the above studies a mobile application with certain features was developed to automate administrative tasks and interviews were conducted to determine what features are required before development starts. While the study conducted by Lilljebjörn Rusk and Ejlertsson (2020) did not take place in the same environment, it provided a proper feature set for a mobile application that provided the users with a suitable solution for their problem. The study conducted by Ssempala *et al.* (2018), on the other hand, was set in an educational environment but a limited amount of features were discussed and added into the mobile application. The means of feature investigation from Lilljebjörn Rusk and Ejlertsson's study could be used in this study to ensure that the mobile application fully satisfies the users; while the necessity before nice-to-have approach from Ssempala *et al.* (2018) can be used to ensure that all the important aspects of the

mobile application are developed first. According to Flora *et al.* (2014), their finding of various desirable features can aid in the development of any type of mobile application. The mobile application in this study will be an administrative application and the features mentioned by Flora *et al.* (2014) can act as a guide in the development of this application. Through the review of various studies, it has been identified by the researcher that there is a lack of studies related to features of administrative mobile applications and this study could provide information on that topic.

## 3.4  Conclusion

In this chapter the description and problem of this study was provided to gain an understanding of what key concepts and topics can be used to source and analyse pertinent literature. The key concepts of automation, feature(s), tutoring, and mobile application(s) were discussed in detail— with research from various other literary sources. The cause and effect of automation was discussed, along with what components are needed for automation. The term feature was defined by looking at many definitions that exist thereof, and a phenomenon known as feature creep was also briefly explained. The meaning of and approaches to tutoring was discussed along with the need and reasons for tutoring. A discussion of mobile application(s) included the use of mobile applications and what type of mobile applications exist today. These key concepts form part of central topics of this study. Other studies with similar central topics were found, analysed, and compared to this study. These studies provided helpful insights to what gaps there are in various spheres of academia and where this study can fill those gaps. These studies were executed recently, with one study conducted less than a year prior to the writing of this dissertation and the other study conducted two years prior to the writing of this study and the last study conducted six years prior to this study. These studies therefore contain new and relevant information that can be utilised in this study.

# CHAPTER IV: EMPIRICAL WORK

## 4.1 Introduction

In this study, a mobile application will be developed to automate scheduling and administrative tasks for a primary and secondary school tutoring enterprise. This chapter will discuss the empirical work done in this study. Firstly, it is important to revisit the research design and the reviewed literature. The research design describes what methods are used while collecting and analysing data. The literature review is used to inform the empirical work. The empirical work includes the explanation and execution of the data collection and data analysis methods applicable to this study. Moreover, participants are discussed to determine various characteristics of the sample. Individual interviews are used to gather information from participants. The responses from each of the participants are transcribed and analysed to determine what requirements they have with regards to the mobile application. To understand the participants' perceptions from the responses, open coding is used. After analysis is done, the results are discussed to reach a consensus as to what requirements must be included in the mobile application.

## 4.2 Overview of literature review

The literature review provides background to the problem that is addressed in the study and how similar problems were solved in other studies with the same central topics (Ashford Writing Center, 2020). The central topics applicable in this study include automation, feature(s), tutoring and mobile applications(s). The investigation and analysis of these studies informs the empirical work by providing information on what features and functions are usually required from administrative mobile applications. Similar studies also revealed what questions can be asked in interviews to best determine what features and functions users require from their mobile application. One study explained methods they used in their empirical work that can also be used by this study. This method consists of creating necessary functions before creating nice-to-have features, this will ensure that the important aspects of the mobile application is finished first.

## 4.3 Overview of research plan

The research plan describes the methodology, paradigm, data collection, and data analysis methods that are followed in the study (Bell *et al.*, 2018). It is necessary to discuss the methods that are followed and why these methods are chosen, since it is applied in this chapter.

### 4.3.1  Research Design

The research design followed in this study can be visually represented by the research onion. Each layer of the research onion describes the philosophy, approach, methodology, paradigm, time horizon, and data collection and analysis methods (Saunders *et al.*, 2011). To reiterate from the research plan, the research onion starts with the outer layer and ends in the centre layer. The table below shows the chosen type of each layer applicable in this study along with the reason for each choice:

**Table 4.3-a: Research Onion Choice Explanation**

| Research Onion Layer | Type | Reason |
|---|---|---|
| Philosophy | Interpretivism | The emotions, opinions, and perceptions of the participants are required in the study. |
| Approach | Induction | Describes the methodology that will be used. Induction deals with qualitative methodologies and moves observation to theory over time. |
| Methodology | Mono-method Qualitative | Mono-method is used since only one data collection method is used. The data is qualitative because the perceptions and personal experiences of the participants is collected. |
| Paradigm | Action Design Science | Design science is coupled with action research. This paradigm is used since an artefact will be developed (design science) to solve a problem for a unique group (action research). |
| Time Horizon | Cross-sectional | A cross-sectional time horizon is used since the current perceptions of participants are considered. |
| Data collection and analysis methods | Data collection: Individual interview | Qualitative data will be collected. Interviews allow the researcher to collect more personal data from interviewees. Furthermore, participants can answer questions from their own perspective without being influenced by others. |
| | Data analysis: Content analysis with open coding | Content analysis with open coding will be used since appropriate topics can be grouped together and used to make inferences and conclusions. |

The research questions can be answered by conducting the study using the appropriate types of each layer in the research onion. This study revolves around the emotions, perceptions and personal experiences of the participants and the research design should therefore be qualitative

in nature (Sofaer, 2002:195). The research questions in this study are based on enhancing the personal experiences of the employees at the tutoring enterprise by automating their administrative and scheduling tasks. The research design describes a framework that should determine factors like what the personal experiences of the employees are and what tasks they do that must be automated by the mobile application. Once these factors are determined the research questions will be answered.

## 4.3.2   Data Collection method

Data collection is an important part in the research plan and the researcher should always aim to collect quality data since the data is analysed and then used to build answers for the research questions (Kabir, 2016:202). In this study, qualitative data will be collected since the participants' perceptions are significant. Collecting qualitative data allows the participants to voice their own feelings, opinions, and experiences (Choy, 2014:102). There are various data collection methods that can be used for various types of research and according to Kabir (2016:202), the best suited method should be chosen to ensure accurate and truthful data collection.

According to Choy (2014:102), qualitative data can be collected with instruments such as questionnaires, interviews, or sampling and is often open-ended to allow users to give their answer without being influenced by other factors. For this study, one-to-one interviews will be used. Interviews allow the researcher to ask questions and gather data from the answers and the body language of the participants (Doody and Noonan, 2013). A richer and deeper understanding of the data can be gathered through interviews, and are therefore best for studies where it is necessary to truly understand the participants' opinions and emotions; as they are encouraged explain their opinion(s) (Gill *et al.*, 2008:292).

There are different types of interviews including structured, semi-structured and unstructured (Choy, 2014:211;Doody and Noonan, 2013). The interview in this study will be structured. In structured interviews, all the participants are asked the same questions in the same order and manner and the questions are constructed before-hand (Doody and Noonan, 2013). Choy (2014:212) suggests that structured interviews should be used when the topic is well understood by the participants and there is a central focus that is discussed.

Interviews are appropriate for this study since the data that must be collected is based on the opinions, experiences, and perceptions of the participants. The data must be deeply understood so that it can be analysed correctly, and the correct conclusions can be drawn. The data from the interview(s) will determine what features and functionalities the participants require from the mobile application. The interview(s) will also determine what administrative tasks they have, and therefore determine what tasks must be automated.

As required for structured interviews, the questions are constructed before-hand. The interview questions for this study consist of both open-ended and close-ended questions. Also, the participants consist of employees at the tutoring enterprise in question. There are a set of questions for the tutors and a set of questions for the office employees—since these two groups of require different things from the mobile application. For a complete description of the participants refer to Section 5: Participants (p.g. 4). The questions are formulated to determine what tasks the employees have that must be automated and what their work routines include. The data gathered from their work routines will be used to determine what features and functionalities the application should include.

See appendix A for the interview questions.

### 4.3.3 Data Analysis method

Data analysis is performed by identifying key concepts from the collected data and linking these elements in such a way that conclusions can be drawn from the data (Silverman, 2013). There are various methods that can be followed to analyse data including content analysis, narrative analysis, discourse analysis, and grounded theory (Bhatia, 2018). In this study, content analysis will be used. Once the data has been collected with an interview as described in the section above, the data will be transcribed and analysed. According to Elo and Kyngäs (2008), content analysis consists of three phases including preparation, organising and reporting. The process for each of these processes are discussed below.

### 4.3.3.1 Preparation

Key words are used as a unit for analysis. For each question, the key words will be marked from the answers and grouped together. To make sense of these groupings, the 5W questions (*Who? What? Where? When?* And *Why?)* are asked and the answers are found from the groupings.

### 4.3.3.2 Organising

Once the preparation of the data has been completed, open coding is done. Open coding requires reading the data and making notes on the words that stand out and is applicable to the study. The notes are collected and written on coding sheets and informally categorised. Similar categories are grouped together, and outlier categories are grouped in their own category. The various categories are then described and given a description that accurately describes the information within the category.

### 4.3.3.3 Reporting

The results are discussed by using a model, conceptual map, or categories. The report should draw clear conclusions about the data and contain enough detail to answer the research questions and help readers understand what the data means (Elo and Kyngäs, 2008:109).

## 4.4 Participants

The participants included employees from the primary and secondary tutoring enterprise that this study is based on. The targeted number of participants was four or five employees—but the actual number of participants was four (n=4). Three (n=3) of the participants are tutors only; none of the participants are office employees only; and one (n=1) of the participants are both a tutor and office employee. All the participants volunteered to take part in the study and signed a written consent form. All the participants have worked at the tutoring enterprise for more than one year.

See appendix B for the consent form.

A consent form was disseminated to all potential participants via email that they were asked to complete it if they volunteer to take part in the study. Four of the potential participants expressed interest in taking part in the study. An interview time and location were discussed with each of the participants. At the interview location, it was explained to the participants that they will be asked questions applicable to their position at the tutoring enterprise and that they must answer it with their honest and full opinion. The participants were informed that the interview session will be recorded to aid with transcription. Each participant was called into the room individually and the interview session began, and the recorder was started. The questions were asked sequentially, and the participant was given a chance to answer the question. Once the interview session was done, the participant was thanked and allowed to leave. After all the interviews were finished, the answers to the interview questions from each participant was transcribed in table format.

See appendix C for the full transcripts of the interviews.

## 4.5 Data analysis

Content analysis will be used to analyse the data in an inductive manner since the data is qualitative (Elo and Kyngäs, 2008:109). This prescribes certain steps that must be followed, these steps are divided into three phases: preparation, organising, and reporting (Elo and Kyngäs, 2008:109). Steps one and two form part of the preparation phase, steps three to seven form part of the organising phase and step eight forms part of the reporting phase. These steps will be utilised in the appropriate phases below.

### 4.5.1 Preparation phase

Key words and sentences will be used as the unit of analysis. Key words and sentences found in the data will be noted and used as part of phase two (organising phase). This phase requires the researcher to read through the data multiple times and answer the following questions (Dey, 2003:68):

*Who* is talking?

The data is gathered from tutors and/or office employees at a tutoring enterprise. Some of the tutors are students.

*Where* is it taking place?

The data is concerned with a primary and secondary school tutoring enterprise in Vanderbijlpark. The data explains what happens in the foyer where students arrive and their various classrooms.

*When* did it take place?

For the tutors, the data describes events that takes place daily or some days of the week when a student or group arrive for class. This can be hourly or every hour and half in that day. For the office employees the data describes events that take place daily, weekly, and monthly during office hours. Some of the events might differ in the day or week if students have upcoming tests or examinations.

*What* is taking place?

Data collected from tutors describe that they give class on various subjects to different grades. The data describes what activities they complete from when a student or group arrives for class up until they leave. They use a calendar to know which and when student(s) should attend. The tutors only give class to the students that have been scheduled on the calendar. Data collected from office employees describe what HR related functions and administrative tasks they complete daily, weekly, and monthly. The HR function includes activities related to the tutors and other workers (e.g. paying salaries). Administrative tasks include what they must do each day to ensure everything is ready when students arrive. Weekly administrative tasks include preparing for the week to come and starting with tasks that need to be ready by month-end. Monthly tasks include concluding tasks that are done weekly and preparing for the next month.

_Why_ is it taking place?

The tutors and office staff perform the activities since it is their job and responsibility. Most likely, they have these responsibilities because it forms part of what makes the enterprise succeed. The way they do these activities are what they had available at the start of the enterprise.

### 4.5.2   Organising phase

The organising phase of content analysis includes open coding, creating categories from open coding and naming categories (Elo and Kyngäs, 2008:111). Open coding includes reading through the data and noting any key words and sentences that stand out in the data, the key words and sentences gathered from open coding will be added to tables where each table represents each question.

#### 4.5.2.1   Open coding of work routine questions

The open coding of the work routine questions is presented in the tables below.

**Table 4.5-a: Open coding analysis of answers for question one of the work routine questions**

| Question: Are you a tutor, an office employee, or both? | |
|---|---|
| **Assigned code** | **Answer** |
| **One** (n=1) of the participants is a **tutor and an office employee**. | _"Both"_ |
| **Three** (n=3) of the participants are **tutors** | _"...tutor"_ |
| | _"...tutor..."_ |
| | _"A tutor"_ |

**Table 4.5-b: Open coding analysis of answers for question two of the work routine questions**

| Question: What are your responsibilities as this/these role(s)? | |
|---|---|
| **Assigned code** | **Answer** |
| One (n=1) participant has the responsibility of **completing administrative and human-resources tasks**. | _"…complete admin and HR-functions..."_ |
| One (n=1) of the participants **teach accounting and economical business studies**. | _"…give mathematics, accounting, and economical business studies class."_ |

| Question: What are your responsibilities as this/these role(s)? | |
|---|---|
| **Assigned code** | **Answer** |
| All (n=4) the participants **present mathematics classes**. | *"I give maths..."* |
| | *"I give mathematics in English..."* |
| | *"…give mathematics class..."* |

### 4.5.2.2 Open coding of tutor questions

The open coding of the tutor questions is presented in the tables below.

**Table 4.5-c: Open coding analysis of answers for question one of the tutor questions**

| Question: Approximately how many students are in your class in each session? | |
|---|---|
| **Assigned code** | **Answer** |
| There are **between one and five students** in a class. | *"1 to 5 learners."* |
| | *"…mostly one-on-one, but I have one group of 3."* |
| | *"I have one student at a time..."* |
| | *"I have 1 to 2 learners per class."* |

**Table 4.5-d: Open coding analysis of answers for question two of the tutor questions**

| Question: What is your routine from when a student arrives until they leave? | |
|---|---|
| **Assigned code** | **Answer** |
| Two of the tutors **prepare for the upcoming class**. | *"I try to arrive 15 minutes earlier to prepare..."* |
| | *"…I will make sure all their things are ready…"* |
| All the tutors **work through the COVID-19 checklist** with the student, **take their temperature and sanitize their hand**s. | *"…I work through the COVID checklist with them, take their temperature and sanitize both learner and my hands."* |
| | *"…sign them in by taking their temperature and let them fill in the COVID forms..."* |
| | *"…I will help them with sanitizing their hands, taking their temperature, and answering the questions that are needed due to COVID."* |
| | *"…I go through the COVID checklist with them, take their temperature and sanitize their hands..."* |
| Two of the tutors let **the students collect their workbooks**. | *"I then request that the learner collects his/her book and file..."* |
| | *"…I then ask them to collect their book."* |
| All the tutors **teach** the applicable subject to the student(s). | *"I collect the previous weeks' homework and mark whilst learner completes a quick warmup exercise. I then explain the mistakes made by learner on homework – if any. I also ask the learner the following questions:*<br>*'Do you have any homework which you are struggling with now?', if yes, I assist learner with the homework. 'Do you have any exams / tests coming up?', if yes, copy the relevant units in terms of the demarcation."* |
| | *"…I would lead them to the class, and we will have class. I would then proceed to give class until the hour and a half is up."* |
| | *"We will then go to class where I will teach them the material for the day…"* |

| Question: What is your routine from when a student arrives until they leave? | |
|---|---|
| Assigned code | Answer |
| | *"I give class by revising any homework they might be struggling with and discuss the topic they are busy with at school."* |
| Three of the tutors **provide the student with homework** after class. | *"I copy homework and give it to the learner after the session."* |
| | *"…provide them with homework."* |
| | *"I print homework and give it to the learner."* |
| Three of the tutors ask the learner to **sanitise their work area and seat**. | *"I ask the learner to sanitize his/her workspace…"* |
| | *"…fetch the sanitiser and paper towels so that we can clean their table and chair."* |
| | *"I ask them to sanitise where they worked…"* |
| All the tutors **sign the student out** by taking their temperature. | *"…sign the learner out by taking his/her temperature."* |
| | *"…thereafter I would sign them out…"* |
| | *"I will take their temperature and ensure they sanitize their hands again."* |
| | *"…I take their temperature to sign them out."* |
| All the tutors **complete their timesheets to record the student's attendance**. | *"Lastly, I would complete my timesheet."* |
| | *"…fill in my timesheet…"* |
| | *"Once they have left, I will record their times into my schedule…"* |
| | *"…then complete my timesheet to record the attendance of the learner."* |

**Table 4.5-e: Open coding analysis of answers for question three of the tutor questions**

| Question: Are there tasks in your routine that you feel could be easier, and if so, which tasks? | |
|---|---|
| Assigned code | Answer |
| Two of the tutors feel **completing their timesheets** should be easier | *"Completion of my timesheets..."* |
| | *"I wish there were an easier way to complete my timesheets..."* |
| Two of the employees feel that **none of their tasks** could be easier. | *"I do not think so..."* |
| | *"No, I am very much happy with how my tasks flow..."* |

**Table 4.5-f: Open coding analysis of answers for question four of the tutor questions**

| Question: Please describe how you know when which student is attending for class? | |
|---|---|
| Assigned code | Answer |
| All (n=4) the participants **receive their schedule via WhatsApp** prior to their classes. Two of the participants mentioned that the **schedule is posted against the wall** at the enterprise premises. | *"…sends a schedule via WhatsApp and one is provided on the wall."* |
| | *"…let me know in the form of a WhatsApp or a call."* |
| | *"Our schedules are usually sent to us before the week starts...", "The week's schedule is also posted on the pinboard"* |
| | *"We receive a schedule beforehand that is sent to us on WhatsApp."* |

**Table 4.5-g: Open coding analysis of answers for question five of the tutor questions**

| Question: Are you currently satisfied with this method? Is there a way you feel this could be easier? | |
|---|---|
| **Assigned code** | **Answer** |
| Two (n=2) of the participants are **satisfied** with the method. | *"Yes, I am satisfied"* |
| | *"Yes, I am currently satisfied…"* |
| Two (n=2) of the participants feel the **method could be improved**. | *"Sometimes the office employee forgets to notify us"* |
| | *"The method works as best it can."* |
| One (n=1) of the participants feel that the method can be easier by:<br>**- letting parents confirm their booking on an application,**<br>**- allowing parents to book classes,**<br>**- allowing employees to approve bookings,**<br>**- notifying tutors of changes,**<br>**- attendance of student should be noted on an application.** | *"…if there is a fixed schedule where parents have to confirm their booking...", "…allow parents to book their lessons...", "…the office employee needs to approve the booking...", "…notify tutors immediately of all the changes made...", "Also, when a student arrives or cancels a class, the tutors should be able to note this change..."* |
| One (n=1) of the participants feel that the method can be easier by **allowing users to sign in on a device that will show their timesheets and schedule.** | *"…learners or tutors can sign in and it automatically shows our timesheet and schedule."* |

### 4.5.2.3 Open coding of office employee questions

The open coding of the work routine questions is presented in the tables below.

**Table 4.5-h: Open coding analysis of answers for question one of the office employee questions**

| Question: What is your weekly routine as an office employee? | |
|---|---|
| **Assigned code** | **Answer** |
| The office employee (n=1) **schedules extra classes** for students with upcoming tests. | *"I schedule learners for additional sessions as per their tests/ assessments and make necessary adjustments to accommodate all the learners..."* |
| The office employee (n=1) **performs a stock check**. | *"I consider if any goods need to be purchased...", "I check the printers to see if they have sufficient paper and ink... "* |

| Assigned code | Answer |
|---|---|
| **Printing work is done** for the week, this includes:<br>**- copies of the prior week's timesheets**<br>**- weekly schedules**<br>**- copies of prior tests** | "...make copies of the timesheets", "I print out weekly schedules and hang them up on the walls.", "… make copies of prior exams..." |
| **Maintenance tasks are completed** for the week, these include:<br>- **review prior week's timesheet**,<br>- perform weekly **preparation**<br>- **cycle clean the printers**<br>- **notify tutors of changes**<br>- **review statements** for faults and **confront overdue fees** | "I review prior week's timesheet...", "…weekly preparation for learner's tests...", "…I do a clean cycle on the printers", "I also notify tutors of any changes.", "…follow up on discrepancies in the statements and long-overdue tuition fees." |

**Table 4.5-i: Open coding analysis of answers for question two of the office employee questions**

| Question: Approximately how much time do the tasks in your weekly routine take up? | |
|---|---|
| **Assigned code** | **Answer** |
| Weekly tasks take an average of **28 hours per week** for the office employee (n=1). | *"28 hours weekly on average."* |

**Table 4.5-j: Open coding analysis of answers for question three of the office employee questions**

| Question: What is your monthly routine as an office employee? | |
|---|---|
| **Assigned code** | **Answer** |
| The office employee (n=1) **sends the statement**s to the parents. | *"…email statements..."* |
| **Calculate and pay monthly wages.** | *"…calculate monthly wages and perform payments of tutors, cleaning staff and others."* |
| **Monthly expenses are reviewed**. | *"...reconcile expenses…"* |
| **Plan schedules** for the upcoming month and **notify tutors and parents** with the preliminary schedule. | *"Lastly, I plan schedules and notify tutors and parents…"* |

**Table 4.5-k: Open coding analysis of answers for question four of the office employee questions**

| Question: Approximately how much time do the tasks in your monthly routine take up? | |
|---|---|
| **Assigned code** | **Answer** |
| Monthly tasks take about **16 to 24 hours at the end of the month** for the office employee. | *"16 to 24 hours in the course of 3 days at the end of the month."* |

**Table 4.5-l: Open coding analysis of answers for question five of the office employee questions**

| Question: Are there tasks in your weekly and monthly routine that you feel could be easier? | |
|---|---|
| **Assigned code** | **Answer** |
| The office employee (n=1) feels that the following tasks could be easier: <br> **- scheduling classes** <br> **- notifying parents and tutors** <br> **- reconciling expenses** <br> **- constructing statements** | *"Scheduling learners and notifying parents and tutors, as well as reconciling expenses and constructing statements"* |

### 4.5.2.4 Open coding of mobile application questions

The open coding of the work routine questions is presented in the tables below.

**Table 4.5-m: Open coding analysis of answers for question one of the mobile application questions**

| Question: Which of your tasks do you feel should be automated by the mobile application? | |
|---|---|
| **Assigned code** | **Answer** |
| The office employee (n=1) feels that **planning and scheduling of learners** should be automated. | *"Planning and scheduling of learners."* |
| The office employee (n=1) feels that **statements should be generated automatically**. | *"Automated statements generation function."* |
| Three of the participants (n=3) feel that the **attendance timesheets** should be automated. | *"...it would be the attendance; it could be electronical…"* |
| | *"...the timesheets…"* |
| | *"Automatic generated timesheet."* |

**Table 4.5-n: Open coding analysis of answers for question two of the mobile application questions**

| Question: Please describe how you think the task(s) should be represented by the mobile application? | |
|---|---|
| **Assigned code** | **Answer** |
| **A statement should automatically be generated using the student's schedule information.** | *"Every time a learner is scheduled the application should automatically bill the parent for the hour(s)…"* |
| Two of the participants (n=2) feels that the **information needed on the timesheet should be entered on the device** as the student attends. | *"...each tutor has their own attendance forms on the device and just type in their students name in and full in the information as they enter."* |
| | *"I would prefer the same format that it is currently but just made available for an application"* |
| One of the participants (n=1) feel that the **information about the student should already be available and they just must choose if the student attended or not from a drop-down list.** | *"Every time a learner is scheduled the application should generate an on-screen timesheet with the already existing name of learner. When the learner attends, we can just select from a drop-down list"* |

**Table 4.5-o: Open coding analysis of answers for question three of the mobile application questions**

| Question: Which of these functionalities and/or features do you feel should be in the application?<br>• Role-based Functions<br>• Log in before making changes<br>• Record attendance of students<br>• Access student/ employee details | |
|---|---|
| **Assigned code** | **Answer** |
| Two of the participants (n=2) feel that **role-based functions, log in before making changes and recording of attendance** should be available on the application**.** | *"There should be role-based functions, log in before making changes, and recording of attendance of students."* |
| | *"Role-based Functions, log in, and record attendance of students."* |
| Two of the participants (n=2) feel that **all the options** should be available on the application. | *"All of the options should be available"* |
| | *"All of the options."* |

**Table 4.5-p: Open coding analysis of answers for question four of the mobile application questions**

| Question: What benefits would the development of such an application pose to the enterprise (as a whole)? | |
|---|---|
| **Assigned code** | **Answer** |
| All the participants (n=4) feel that it would **make their tasks less time consuming**. | "It would be time saving." |
| | "I think it would spare us a few minutes..." |
| | "It would be less time consuming…" |
| | "It would save us a lot of time." |
| One of the participants (n=1) also felt that it would **make the enterprise more efficient and accurate.** | "...as well as provide more efficiency and accuracy" |

**Table 4.5-q: Open coding analysis of answers for question five of the mobile application questions**

| Question: What mobile devices are / should be used to run such an application? (iPad, iPhone, Samsung tablet(s), etc.) | |
|---|---|
| **Assigned code** | **Answer** |
| Three of the participants (n=3) suggested that the device should be **any Android device.** | *"Any tablet or Android device…"* |
| | *"Any Android device."* |
| | *"Any tablet or Android device…"* |
| One of the participants (n=1) suggested that the device should be **any cell phone**. | *"...I would suggest what we have like a cell phone…"* |
| One of the participants (n=1) also suggested that the device is a **personal computer or laptop.** | *"...or pc…"* |

**Table 4.5-r: Open coding analysis of answers for question six of the mobile application questions**

| Question: Does the enterprise have the infrastructure (internet connectivity, devices, technical know-how) to support such a mobile application? | |
|---|---|
| **Assigned code** | **Answer** |
| All the participants (n=4) think **the enterprise has the sufficient infrastructure.** | *"Yes."* |
| | *"Yes."* |
| | *"Yes..."* |
| | *"Yes."* |

**Table 4.5-s: Open coding analysis of answers for question seven part one of the mobile application questions**

| Question: Would the enterprise be able to sustain and maintain such an application in the foreseeable future? | |
|---|---|
| **Assigned code** | **Answer** |
| Two of the participants (n=2) that the **enterprise could maybe sustain and maintain the application.** | *"Yes and no."* |
| | *"I am unsure, but it is possible"* |
| Two of the participants (n=2) feel that **the enterprise would be able to sustain and maintain the application.** | *"Yes"* |
| | *"Yes, for the enterprise."* |

**Table 4.5-t: Open coding analysis of answers for question seven part two of the mobile application questions**

| Question: Please elaborate on your previous answer. | |
|---|---|
| **Assigned code** | **Answer** |
| **No because the application can lead to unplanned IT expenses**. | *"Maintaining such an application would give rise to IT expenses not yet considered…"* |
| **No because human intervention is still required.** | *"Many of the application functions would still require human intervention…"* |
| **No because other administrative tasks will need to be done**, for example training. | *"...it would give rise to other administrative duties which would require time."* |
| | *"...I am not very computer literate and will have to receive training on how to use the technology."* |
| **Yes, because there is an existing infrastructure that does include some technology and most people are technology literate.** | *"...we are used to working with technology therefor it just makes sense that we will be able to sustain and maintain."* |
| | *"It is possible for the company to sustain and maintain this future of technology..."* |
| | *"The enterprise has the infrastructure to sustain the system…"* |

**Table 4.5-u: Open coding analysis of answers for question eight of the mobile application questions**

| Question: Which of the following colour schemes do you feel is suitable with regards to the interface? Theme A, Theme B or Theme C | |
|---|---|
| **Assigned code** | **Answer** |
| Two (n=2) of the participants chose theme A | *"Theme A"* |
| | *"Theme A"* |
| One (n=1) participant chose theme B | *"Theme B"* |
| One (n=1) participant chose theme C | *"Theme C"* |

### 4.5.2.5  Categorisation of open coding results

The key words and themes gathered from open coding are categorised and given descriptive headings that will explain what information the categories entail. From these categories, the report is written. In the tables below the key words and sentences will be categorised. For each category, a description is given that explains the contents of the category.

**Table 4.5-v: Employee description category**

| Category | Key words and theme(s) |
|---|---|
| Employee description | Tutor and an office employee. |
| | Three tutors. |
| | Completing administrative and human-resources tasks. |
| | Teach accounting and economical business studies. |
| | Present mathematics class. |

This category describes the employees that are working at the enterprise. Three (n=3) of the participants are tutors and one (n=1) of the participants is a tutor and office employee. The tutors present classes on various subjects and the office employee has the responsibly of completing all administrative and human-resources tasks at the enterprise.

**Table 4.5-w: Tutor tasks category**

| Category | Key words and theme(s) |
|---|---|
| Tasks completed by the tutors | Receive their schedule via *WhatsApp* and it is posted against the wall. |
| | Prepare for the upcoming class. |
| | Between one and five students are in a class. |
| | Work through the COVID-19 checklist with the student, take their temperature and sanitize their hands. |
| | Students collect their workbooks. |
| | Teach the applicable subject to the student(s). |
| | Provide the student with homework after class. |
| | Sanitize their work area and seat. |
| | Sign the student out. |
| | Complete their timesheets to record the student's attendance. |

The category in Table 4.5-w describes the tasks tutors at the enterprise complete daily as they present classes. All the tutors know which and when students are attending their class by referring to the schedule that they have received via a *WhatsApp* message or the schedule posted against the wall at the premises of the enterprise. Only some of the tutors choose to prepare for the

upcoming class. Once the students arrive—which can be between one and five students—the tutors must take their temperature, sanitise their hands, and fill in the COVID-19 checklist with them. The tutors then ask the students to collect their workbooks from the shelf, or they collect it before class. The class commences and could be an hour or an hour and a half. At the end of the class some of the tutors provide the students with homework. The tutors then ask the students to sanitise the area where they worked and take their temperature to sign them out. Once the student has left, the tutor records their attendance with a pen on their paper-based timesheet.

**Table 4.5-x: Satisfaction of the way tutor tasks are completed category**

| Category | Key words and theme(s) |
| --- | --- |
| Satisfaction of the way tasks are completed by the tutors. | Satisfied. |
| | None of their tasks could be easier. |
| | Completing their timesheets should be easier. |
| | Method of knowing when and what students are attending could be improved. |
| | Notifying tutors of changes can be improved. |

In the table above describes tutor satisfaction with regards to how tasks are completed at the enterprise. Two of the employees agree that the way tasks are handled currently does not need improvement and the other two employees agree that some of the tasks could be easier. Although two of the employees feel the way tasks are done is easy enough, they later stated that they do have tasks that they wish could be automated and that this automation could save them a lot of time. This is stated in Table 4.5-dd and Table 4.5-ee. The tutors that stated that their tasks could be made easier, mentioned that the method of doing the following tasks could be improved:

- Completing their timesheets;
- The method used to let tutors know when and which students are attending for class; and
- Notifying tutors of changes that were made.

**Table 4.5-y: Methods to improve tutor tasks category**

| Category | Key words and theme(s) |
| --- | --- |
| How tasks completed by the tutors can be improved. | Attendance of student should be noted on an application. |
| | Allowing users to sign in on a device that will show their timesheets and schedule. |
| | Attendance timesheets should be automated. |
| | Information needed on the timesheet should be entered on the device. |
| | Information about the student should already be available and they just must choose if the student attended or not from a drop-down list. |

The tutors that felt their tasks could be made easier expressed ways in which they feel the tasks could be improved upon. As such, the tutors mentioned that the method of completing their timesheets should be automated with an application and that relevant student information should be captured or the student information should already be available and chosen from a drop-down list if they attended or not. The latter option would be better, since it would ensure that student information is entered correctly. The tutors should be able to sign in to view their individual timesheet and schedule. This is a viable option, but tutors should only have to sign in when changes are made. The other tutors should be able to see other tutors' schedule so that they can refer students to their teacher if needed.

**Table 4.5-z: Weekly office employee tasks category**

| Category | Key words and theme(s) |
|---|---|
| Weekly tasks completed by the office employee. | Schedules extra classes for students with upcoming tests weekly. |
| | Performs a stock check weekly. |
| | Printing work is done for the week, this includes: <br> - copies of the prior week's timesheets <br> - weekly schedules <br> - copies of prior tests |
| | Maintenance tasks are completed for the week, these include: <br> - review prior week's timesheet, <br> - perform weekly preparation <br> - cycle clean the printers <br> - notify tutors of changes <br> - review statements for faults and confront overdue fees |
| | 28 hours per week. |

The table above categorises the tasks that are completed by the office employees on a weekly basis. These take up an average of 28 hours per week. Each week the employee must schedule classes for the upcoming seven days and notify tutors of changes made to the schedule. This individual also does a stock check each week to determine if there are enough supplies for the upcoming week. Every week certain printing work is done, including making copies of the prior week's timesheets, making copies of old tests to use during the week for test preparation, and printing the weekly schedules to put up on the pinboard. Some maintenance tasks must also be done each week—including the review of the prior week's timesheets and adding the attendance of students to the preliminary statements. These statements are also reviewed for faults and overdue fees are investigated. Each week preparation must also be done for the coming week. Other maintenance tasks include cleaning the printers.

**Table 4.5-aa: Monthly office employee tasks category**

| Category | Key words and theme(s) |
|---|---|
| Monthly tasks completed by the office employee. | Sends the statements to the parents. |
| | Calculate and pay monthly wages. |
| | Monthly expenses are reviewed. |
| | Plan schedules for the upcoming month and notify tutors and parents with the preliminary schedule. |
| | 16 to 24 hours at the end of the month. |

The table above categorises the monthly tasks that are completed by the office employee. The monthly tasks take the employee 16 to 24 hours during approximately three days at the end of each month. Each month the statements are sent to the parents, the month's wages are calculated and paid towards tutors, cleaners and other employees, and the expenses that occurred during the month are reviewed. The employee must also plan the class schedules for the upcoming month. This preliminary schedule is then sent to the tutors and parents.

**Table 4.5-bb: Satisfaction of the office employee tasks are completed category**

| Category | Key words and theme(s) |
|---|---|
| Satisfaction of the way tasks are completed by the office employee. | Scheduling classes could be easier. |
| | Notifying parents and tutors could be easier. |
| | Reconciling expenses could be easier. |
| | Constructing statements could be easier. |

Table 4.5-bb shows the satisfaction of the office employee with regards to how the weekly and monthly tasks are completed. This employee feels the following tasks could be made easier:

- Scheduling of classes;
- Notifying tutors and parents about the schedule;
- Reconciling the expenses that occurred during the month; and
- Constructing statements at the end of each month.

**Table 4.5-cc: Methods to improve office employee tasks category**

| Category | Key words and theme(s) |
|---|---|
| How tasks completed by the office employee can be improved. | Parents should be able to schedule their children's classes. |
| | Allowing parents to book classes. |
| | Letting parents confirm their booking on an application. |
| | Allowing employees to approve bookings. |
| | Notifying tutors of changes. |
| | Planning and scheduling of learners. |
| | Statements should be generated automatically. |
| | A statement should automatically be generated using the student's schedule information. |

The table above mentions how the tasks the employee identified in Table 4.5-bb could be made easier. Firstly, the employee suggests that parents should be able to schedule or book their children's classes and confirm these bookings after an employee has approved it. Since this would require parents to work on the device used by the enterprise, it would not be entirely possible. However, it is possible that the parents can notify one of the tutors or office employees of the time and date they would like to book, and an employee could approve and enter this booking on the application. The employees can also confirm the booking on the parent's behalf. The employee in question feels that the application should notify tutors and parents of changes, instead of the employee. This is possible, but it would require the application to store sensitive client information (that should be encrypted). This could lead to various security concerns that have not been considered. The possibilities of storing client information would have to be investigated in a future study. Other ways that the employee's tasks could be improved is for an application to automatically schedule classes based on the times and dates students and tutors have available and statements should also be automatically created for each student based on the timesheets that have been completed on the application.

**Table 4.5-dd: Possible features and functions category**

| Category | Key words and theme(s) |
|---|---|
| Possible features and functions of the application. | Role-based functions, log in before making changes and recording of attendance |
| | All the options (Role-based functions, log in before making changes, record attendance of students, access student/ employee details). |
| | Planning and scheduling of learners should be automated. |
| | Statements should be generated automatically. |

| Category | Key words and theme(s) |
|---|---|
| | A statement should automatically be generated using the student's schedule information. |
| | Attendance timesheets should be automated. |

The table above shows the features and functions that the employees feel the administrative mobile application should include. These features/ functions are listed below:

- Role-based functions which allow employees to access functions specific to their role(s).
- The employees should be able to log in with their details before they can make any changes. This functionality enables logging of changes that were made and would discourage employees from making unnecessary/erroneous changes.
- Classes should be scheduled automatically based on the times and dates students and tutors have available. The times the tutors and students have available would have to be entered manually and stored in a specific format.
- The employees must be able to complete their timesheets on the application by choosing if the student attended or not from a drop-down list.
- Statements should be created automatically for each student based on their attendance as noted on the timesheets that have been completed on the application by the tutors.

**Table 4.5-ee: Benefits and losses with the deployment of the application category**

| Category | Key words and theme(s) |
|---|---|
| Benefits and disadvantages for the enterprise with the deployment of the application. | Make their tasks less time consuming. |
| | Make the enterprise more efficient and accurate. |
| | Enterprise could maybe sustain and maintain the application. |
| | The enterprise would be able to sustain and maintain the application. |
| | The application can lead to unplanned IT expenses. |
| | Human intervention is still required. |
| | Other administrative tasks will need to be done. |
| | There is an existing infrastructure that does include some technology and most people are technology literate. |

The table above mentions various benefits and disadvantages that the enterprise could experience with the deployment of the application for their work environment. The benefits the application would provide includes employees saving valuable time by making the enterprise more efficient and accurate. The enterprise can sustain the application infrastructure since they already utilise substructures that partly consist of technology. Moreover, most of the employees are computer literate and/or proficient with such tools. The disadvantages that the application

pose to the enterprise is that it would cause unforeseen IT related expenses, as it could give rise to new administrative tasks since human intervention with the application is still required. The employees would also have to be trained to use the application. Although there are multiple disadvantages that the application could present, the weight of the benefits versus the disadvantages have not been measured. The application could present short term disadvantages but long-term benefits and *vice versa*. The enterprise is willing to implement an application regardless of the benefits or disadvantages it could present. The effect the application has on the enterprise could also be investigated in a future study.

**Table 4.5-ff: Application platform and interface category**

| Category | Key words and theme(s) |
|---|---|
| Mobile application platform and interface | Any Android device. |
| | Any cell phone. |
| | Two of the employees chose theme A |
| | One employee chose theme B |
| | One employee chose theme C |

The employees do not have a specific device they wish to use for the application and Table 4.5-ff shows that the employees prefer any Android device or cellular phone. It is entirely possible to develop the application for a cell phone but cell phones have limited screen space and would require the application to either show smaller pieces of information at once or make the elements on the screen diminutive. It may, therefore, be better to develop the application for an Android tablet device. The interface should look enticing and function ergonomically for the employees to use throughout the workday. Most of the employees decided on theme A as a colour schema for the interface. This theme can be seen in the figure below:
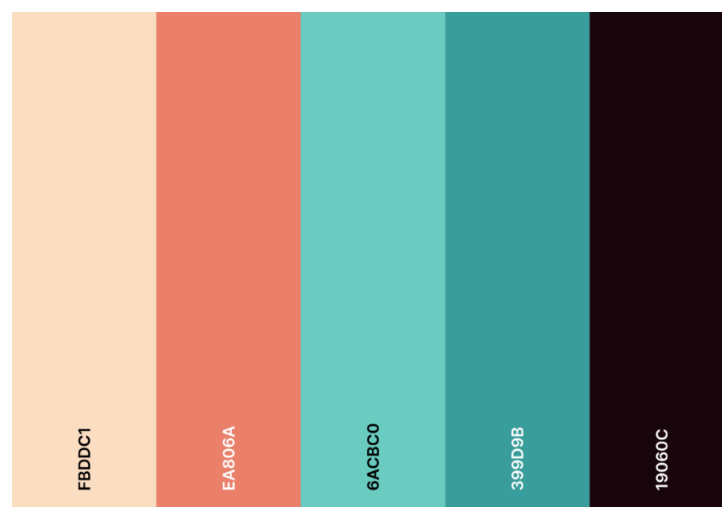


**Figure 4.5-a: Theme A**

### 4.5.3　Reporting phase

The results from the organising phase are used to draw conclusion from the data with regards to the research problem and provide answers to the research questions (Elo and Kyngäs, 2008:109). The organising phase revealed eleven specific categories. Four of these categories describe the employees at the enterprise and what administrative tasks they complete. Four of these categories describe how satisfied the employees are with the method they currently use to complete their tasks, if these tasks can be improved and, how they feel it could be improved. The tasks in those four categories will be considered for automation since it would not benefit the employees to automate tasks that they already find easy to complete. One of the categories describe what features and functions should be included in the application. These features and functions are listed below:

- Role-based functions.
- The employees should be able to log in with their details before they can make any changes.
- Classes should be scheduled automatically.
- The employees must be able to complete their timesheets on the application.
- Statements should be created automatically for each student.

By adding these functions and features to the application, the administrative and scheduling tasks will be automated by using a mobile application. One of the categories describe what device and interface schema should be used for the application. It was determined that the employees prefer any Android tablet/ cell phone.  The application can be created for both tablet and cell phone but since a cell phone has a smaller screen space that a tablet, only certain parts of the application will be shown at once or the information on the screen will be very small on an cell phone. The last category describes how the enterprise will benefit from the implementation of a mobile application for automation. Both benefits and disadvantages rose from the data analysis. The benefits and disadvantages are listed below, respectively:

Benefits

- The use of an application for automation would save the enterprise valuable time.
- Automation with the application could make the enterprise more effective and accurate.

Disadvantages

- Use of an application could lead to unexpected IT related expenses.
- The use of an application would still require some human intervention.

- The use of an application can give rise to new administrative tasks.

As mentioned in the section above, although there are multiple disadvantages, further research is needed to determine if the disadvantages will be long-term or short term. This should also be investigated with for the benefits. Regardless of this, the enterprise is still willing to implement the use of a mobile application for administrative task and scheduling automation. The data analysis has revealed sufficient information to answer the research questions that are applicable in this study.

## 4.6 Conclusion

In this chapter the focus was to perform data analysis with data gathered from the participants. Before data could be analysed, it was necessary to review how previous literature has informed this study, and what research design will be followed during data collection and analysis. Data was collected from participants with individual interviews which was then transcribed and included as an appendix. Data was analysed by using content analysis. Content analysis includes three phases that need to be completed. The first phase, preparation, required the researcher to choose a unit of analysis and read though the data to gain an understanding of the data. The unit of analysis was key words and sentences. In the second phase, organising, open coding was used to determine key words and sentences from the data. These key words are then categorised, explained, and given descriptive headings. Eleven categories were identified in the organising phase and each of these categories describe valuable information. These categories are used in the third phase, reporting, to answer the research questions. The research questions and their answers derived from data analysis are depicted in the table below:

**Table 4.6-a: Answers to the research questions**

| Research question | Answer derived from data analysis |
|---|---|
| What benefits would the development of an application pose to the enterprise? | The following benefits have been identified: <br> - The enterprise would save valuable time. <br> - The enterprise will be more effective and accurate. <br> Some disadvantages have also been identified: <br> - Unexpected IT expenses could occur. <br> - Human intervention will still be required and this will need training to be done. <br> - New administrative tasks could be established. |
| What platform should the application be developed for? | The application can be developed on any Android tablet or cell phone. |

| Research question | Answer derived from data analysis |
|---|---|
| What features and functions are desired by the users to be able to do their administrative tasks more effectively? | The following features and functions are desired by the users:<br>- Some of the functions should only be available to employees with a certain role.<br>- Log in before making changes.<br>- Automatic scheduling of classes.<br>- Completion of timesheets on the application.<br>- Automatically generated statements. |

Since the research questions are answered, the development of the artefact can commence. The information gathered from the data analysis will be used in the development of the mobile application to ensure that the users are satisfied and meet the aim of the study.

# CHAPTER V: CONCLUSION AND SUMMARY

## 5.1  Introduction

The goal of this study is to develop a mobile application prototype that will automate scheduling and administrative tasks for a primary and secondary school tutoring enterprise. This chapter will conclude the study by giving an overview of what transpired in previous chapters of dissertation. As such, each chapter in the study will be summarised here. Furthermore, this chapter will describe the extent to which the objectives and aim(s) of this study were reached. Any limitations of the study will also be listed; followed by suggestions for future research. Finally, it will be explained how this study contributed towards existing literature and pertinent knowledge base.

## 5.2  Summary of the study

This mini dissertation is comprised of a total of five chapters. Each of these chapters will be briefly discussed below.

### 5.2.1  Chapter 1 – Introduction

This chapter proposed the development of a mobile application prototype with the goal of automating various scheduling and administrative tasks for a primary and secondary tutoring enterprise in Vanderbijlpark—since the employees at the enterprise do not have enough time to complete these demanding administrative tasks, leading to decreased performance with regards to customer service, business operations, etc. In this chapter, the research questions, aim, and objectives are defined. Various key concepts that form part of the problem statement were defined since these research aspects play a vital role in the chapters to follow. The foundation of the study is also mentioned in the introductory chapter, in the form of the research methodology and paradigm, data collection/analysis methods, participants, and ethical considerations.

### 5.2.2  Chapter 2 – Research Plan

In the research plan chapter, the research process phases, as stated by Bell *et al.* (2018:4), was discussed according to the chosen methodology and research paradigm. Before the research process phases were discussed, the methodology and paradigm were reviewed and explained more thoroughly than in the previous chapter. The chapter then discussed the goal of the study, the research questions and objectives, the applicable research design, and data collection/analysis methods. Lastly, any preliminary limitations and ethical considerations were mentioned. The goal of this chapter was to set out a plan for the researcher to follow during both the literature and empirical phases of the study.

### 5.2.3 Chapter 3 – Literature Review

The literature review chapter provided deeper understanding by identifying key concepts and then using them to acquire related literature. Similar studies were analysed and compared to this study with the goal of determining the lack of information (gaps) in existing literature. The literature review also allowed the researcher to gain insight into what techniques or methods can be incorporated in this study.

### 5.2.4 Chapter 4 – Data Analysis

The goal of the data analysis chapter was to gather data from participants and implement the chosen data analysis method(s). In this chapter the theoretical information provided in previous chapters were physically applied and it was therefore necessary to review the information from previous chapters. Data was gathered through personal interviews. Content analysis with open coding was used to complete the data analysis. Once data analysis was completed, conclusions were made that would then answer the research questions. Information gathered from this chapter, is used as guidance in the development of the artefact prototype.

### 5.2.5 Chapter 5 – Conclusion and Summary

This is the final chapter of the study and concludes the study. In this chapter, all the chapters in the study are reviewed and explains how the research questions were answered and the objectives were met. The contribution that the study makes to the larger corpus of knowledge was also mentioned. Lastly, the limitations of the study and potential for future research were discussed.

## 5.3 Discussion of research questions and objectives

The objectives applicable in this study relate to the research questions that were set out in chapter 1. The objectives are separated between one primary objective and various secondary objectives. The primary objective of this study is to gain information from participants that could be used as guidance to develop the artefact prototype, which is the aim of the study. The secondary objectives are set in place to aid in completing the primary objective. These objectives are as follows:

- Determine the benefits a scheduling and administrative mobile application pose to the enterprise.
- Determine what device would be best to use for the enterprise.
- Investigate what application features and functionalities are required by the users.

Research objectives are derived from the research questions and require answers to ensure the goal of the study is reached. The sections below will describe how the research questions were answered by referring to the results from the data analysis chapter of the study.

### 5.3.1 What benefits would the development of an application pose to the enterprise?

During the interview, various questions pertaining to the potential effect(s) of the mobile application on the enterprise were answered by participants. These questions ranged from asking whether or not the enterprise had the proper infrastructure to support such a mobile application, to asking how the mobile application would aid the participant. From the data analysis it was determined that the development of a mobile application for the enterprise would yield both benefits and drawbacks. The potential disadvantages outnumbered the benefits, but the enterprise is prepared to implement a mobile application that will automate their tedious administrative and scheduling tasks regardless. With this in mind, the possible value still outweighed the drawbacks offered by such an intervention. The table below lists the benefits and disadvantages as determined through data analysis.

**Table 5.3-a: Benefits and Disadvantages identified for the enterprise**

| Benefits | Disadvantages |
|---|---|
| The enterprise would save a great deal of precious time. | The enterprise could encounter unforeseen IT related expenses. |
| The enterprise could be more productive and accurate. | Some human intervention will still be needed and could require the enterprise to do perform employee training. |
|  | The enterprise could encounter new administrative tasks. |

### 5.3.2 What platform should the application be developed for?

The development of a mobile application could be targeted for almost any cellular device; as this would be suitable for the enterprise's purpose(s). However, it was still necessary to distinguish what device the participants feel would work best. During the interview, the participants were asked which device they prefer to work with. Data analysis determined that the application can be developed for any *Android* tablet or cell phone. The application should therefore be developed for an *Android* device (tablet or cell phone).  Since the screen size of a cell phone is much smaller than that of a tablet, the information might be undersized or only some of the information would be shown at a given time.

### 5.3.3 What features and functions are desired by the users to be able to do their administrative tasks more effectively?

According to Berger *et al.* (2015), the features and functions of an application determines if the application is useful to users. Chen *et al.* (2019) state that users will be unsatisfied with an application that cannot perform the activities required or requested by its user base. One of the important factors when developing a mobile application is thus determining the desired features and functions. During the interview, the participants were asked which of their duties they wish to be automated by the mobile application and what other features they feel should be included in the mobile application. Data analysis revealed various features and functions that the participants wish to see in the application and can be seen below:

- **Role-based functions:** Various functions should only be available to employees with a certain role in the enterprise. The roles can be either *administrator* or *tutor*.
- **User authorization:** Users should log in or provide a password before they can make any changes. These changes can also then be logged.
- **Automation of scheduling:** The application should automatically schedule students for suitable tutors, based on the time and day they are available.
- **Automation of statements:** The application should automatically compile statements based on the attendance of students. This information should be stored and sent to the person(s) responsible for the account.
- **Completion of timesheets:** The employees should be able to record the attendance of students on the application, based on the schedule that was constructed.

Since the research questions were answered, it can be concluded that sufficient information was accumulated to meet the research objectives. The primary objective was achieved by combining the information relating to each secondary objective. The aim of the study was to develop an artefact prototype that would automate the desired administrative and scheduling tasks for the primary and secondary tutoring enterprise under investigation. The design documentation will discuss the development of the prototype itself.

### 5.4 Limitations and future research

The study has various limitations, including:

- Due to the COVID-19 pandemic, the tutoring enterprise which this study is based on had to go through a restructuring process. This reduced the sample size of the participants to 6 employees.

- Since the study is qualitative, content analysis with open coding was used. Qualitative data analysis methods focus on beliefs, experiences, and opinions. The study is therefore limited in its quantitative measures and techniques that could be used. Other research methods or researchers could thus yield different analysis results.
- Due to time constraints, certain aspects of the study could not be completed. This includes iterating the design science process or using more data gathering methods/instruments to gain a full understanding of participants opinions, experiences, and thoughts.

This study only addresses a small portion of the problem that was identified. Larger studies could potentially uncover additional information. Various follow-up studies could therefore be conducted:

- This study was conducted under unique circumstances that required a change in approach. Future studies can conduct a similar study under more normalised conditions with a larger sample size and different analysis methods; since this could give rise to more accurate and reliable trends.
- A future study can oversee the development of the complete artefact rather than just an initial prototype. Without time constraints, the design science process can be iterated until the artefact is the optimal solution.
- The possibility of the application storing sensitive client information can be examined in a future study. This would involve doing extensive research on the security risks and how privacy can be preserved.
- In this study various advantages and disadvantages of implementing a mobile application exists. However, the significance of the advantages versus the disadvantages have not been made clear. A future study can determine if the significance of the advantages surpass the disadvantages in both the short- and long term.

## 5.5    Contributions of the research

This study contributed to existing literature in several ways. In the literature review chapter, it was determined that there is a clear lack in literature with regards to features of administrative mobile applications for tutoring businesses. This study specifically determined the features that are necessary for such an application and will thus contribute to existing literature.

A design science research methodology was followed in this study. The design science process consists of six activities, namely: (1) problem identification and motivation, (2) objective definition, (3) artefact design and development, (4) demonstration, (5) evaluation, and (6) communication. According to Peffers *et al.* (2007), the process can be followed sequentially, but it is possible for the research to start the process at activity one, two, three, or four. For this study, the entry point

will be activity three, which is a design and development centered design. The activities following the design and development activity is demonstration, evaluation, and communication. In this study the requirements of the artefact will be determined before the artefact is designed and developed. Therefore, this study also contributes to advancement of existing methods since it shows that requirements analysis can be done before design and development.

Lastly, since this study aims to develop an artefact that should solve a unique problem that was identified, the study will contribute to design research by developing an artefact to solve the identified problem.

## 5.6   Conclusion

A primary and secondary tutoring enterprise in Vanderbijlpark struggle to keep up with tedious and time-consuming administrative and scheduling tasks. The enterprise needed a solution for this problem since the employees of the enterprise spent more valuable time doing these tasks than directing their focus towards customer service. As a result, the enterprise experiences a decline in productivity and accuracy.

The aim of this study was to develop a mobile application prototype that contains the most sought-after features and functions that would result in the automation of administrative and scheduling tasks for the tutoring enterprise. Various key concepts were vital to this study, these concepts include feature, functionality, mobile application, and automation. These key concepts ground the study to a certain topic that must be understood. The research problem of the study was stated and from this research problem the research objectives were derived.

Once the problem and aim of the study was determined, the research design was constructed. The research design was visualised using the "research onion" (as set out by Saunders *et al.*, 2011). The methodology and paradigm that will be followed throughout the study was determined. The research paradigm consists of principles that guides the actions followed by the researcher (Creswell and Poth, 2016). In this study a qualitative research paradigm will be used. The research methodology should aid the researcher to meet the goal of the study (Bell *et al.*, 2018). For this study, an action design science combination will be used since an artefact must be developed to develop a solution for a unique problem.

By using the key concepts applicable with the chosen methodology and paradigm as frameworks, existing literature was sourced, analysed, and compared with this study. The literature review gives the reader a chance to gain a deeper understanding of the study and allows the researcher to investigate past methods and techniques that can be applied in the study.

The data gathering and analysing method was implemented. Data was gathered using personal interviews and was analysed using content analysis. The open coding method was also used for data analysis. After open coding is completed, the data was grouped into related categories. From these categories various conclusions were drawn that answered the research questions and consequently accomplished the objectives. The aim of the study was completed by developing a mobile application targeted for Android devices with the most sought-after features and functions as determined by the data analysis.

# REFERENCES

Alsubaihin, A. 2016. I Say Requirement, You Say Functionality, They Say Feature! Available: Http://Afnan.Ws/Blog/2016/05/09/Features/ [Accessed 1 May 2020].

Amalfitano, D., Fasolino, A. R., Tramontana, P. & Robbins, B. 2013. Testing Android Mobile Applications: Challenges, Strategies, And Approaches. *Advances In Computers.* Elsevier.

Andre, L. 2020. 47 App Statistics You Can't Ignore: 2020 Market Share & Data Analysis Available: Https://Financesonline.Com/App-Statistics/#Link21 [Accessed 1 May 2020].

Apel, S. & Kästner, C. 2009. An Overview Of Feature-Oriented Software Development. *J. Object Technol.,* 8**,** 49-84.

Arntz, M., Gregory, T. & Zierahn, U. 2017. Revisiting The Risk Of Automation. *Economics Letters,* 159**,** 157-160.

Ashford Writing Center. 2020. *Writing A Literature Review* [Online]. Available: Https://Writingcenter.Ashford.Edu/Writing-Literature-Review [Accessed 28 August 2020].

Avgousti, K. 2013. Research Philosophy, Methodology, Quantitative And Qualitative Methods. *The Cyprus Journal Of Sciences,* 11**,** 33.

Avison, D. E., Lau, F., Myers, M. D. & Nielsen, P. A. 1999. Action Research. *Communications Of The Acm,* 42**,** 94-97.

Bainbridge, L. 1983. Ironies Of Automation. *Analysis, Design And Evaluation Of Man–Machine Systems.* Elsevier.

Baskerville, R., Pries-Heje, J. & Venable, J. Soft Design Science Methodology.  Proceedings Of The 4th International Conference On Design Science Research In Information Systems And Technology, 2009. 1-11.

Bell, E., Bryman, A. & Harley, B. 2018. *Business Research Methods*, Oxford University Press.

Bell, J. 2014. *Doing Your Research Project: A Guide For First-Time Researchers*, Mcgraw-Hill Education (Uk).

Berger, T., Lettner, D., Rubin, J., Grünbacher, P., Silva, A., Becker, M., Chechik, M. & Czarnecki, K. What Is A Feature? A Qualitative Study Of Features In Industrial Software Product Lines.  Proceedings Of The 19th International Conference On Software Product Line, 2015. 16-25.

Bhandari, P. 2020. Data Collection | A Step-By-Step Guide With Methods And Examples. Available: Https://Www.Scribbr.Com/Methodology/Data-Collection/ [Accessed 29 July 2020].

Bhatia, M. 2018. Your Guide To Qualitative And Quantitative Data Analysis Methods. *Data Science* [Online]. Available: Https://Humansofdata.Atlan.Com/2018/09/Qualitative-Quantitative-Data-Analysis-Methods/ [Accessed 21 October 2020].

Bose, S., Scimone, S., Sriraman, N., Duan, Z., Bernstein, A., Lewis, P. & Grosu, R. 2012. Business Process Automation. Google Patents.

Cavanagh, S. 1997. Content Analysis: Concepts, Methods And Applications. *Nurse Researcher,* 4**,** 5-16.

Chen, X., Zou, Q., Fan, B., Zheng, Z. & Luo, X. 2019. Recommending Software Features For Mobile Applications Based On User Interface Comparison. *Requirements Engineering,* 24**,** 545-559.

Choy, L. T. 2014. The Strengths And Weaknesses Of Research Methodology: Comparison And Complimentary Between Qualitative And Quantitative Approaches. *Iosr Journal Of Humanities And Social Science,* 19**,** 99-104.

Cluey Learning. 2019. What Is Tutoring? *Cluey Learning* [Online]. Available From: Https://Clueylearning.Com.Au/Blog/What-Is-Tutoring/ 2020].

Creswell, J. W. & Poth, C. N. 2016. *Qualitative Inquiry And Research Design: Choosing Among Five Approaches*, Sage Publications.

Denzin, N. K. & Lincoln, Y. S. 2011. *The Sage Handbook Of Qualitative Research*, Sage.

Dey, I. 2003. *Qualitative Data Analysis: A User Friendly Guide For Social Scientists*, Routledge.

Doody, O. & Noonan, M. 2013. Preparing And Conducting Interviews To Collect Data. *Nurse Researcher,* 20.

Elo, S. & Kyngäs, H. 2008. The Qualitative Content Analysis Process. *Journal Of Advanced Nursing,* 62**,** 107-115.

Flora, H. K., Wang, X. & Chande, S. V. 2014. An Investigation On The Characteristics Of Mobile Applications: A Survey Study.

Gebauer, J. & Shaw, M. 2002. *A Theory Of Task/Technology Fit For Mobile Applications To Support Organizational Processes*, Citeseer.

Gill, P., Stewart, K., Treasure, E. & Chadwick, B. 2008. Methods Of Data Collection In Qualitative Research: Interviews And Focus Groups. *British Dental Journal,* 204**,** 291-295.

Goetz, H. 2016. What Tutoring Is And What Tutoring Is Not. *Chapman University* [Online]. Available From: Https://Blogs.Chapman.Edu/Scst/2016/02/09/What-Tutoring-Is-And-What-Tutoring-Is-Not/ 2020].

Goodwin, N. C. 1987. Functionality And Usability. *Communications Of The Acm,* 30**,** 229-233.

Greaney, A.-M., Sheehy, A., Heffernan, C., Murphy, J., Mhaolrúnaigh, S. N., Heffernan, E. & Brown, G. 2012. Research Ethics Application: A Guide For The Novice Researcher. *British Journal Of Nursing,* 21**,** 38-43.

Groover, M. P. 2016. *Automation, Production Systems, And Computer-Integrated Manufacturing*, Pearson Education India.

Hart, C. 2018. *Doing A Literature Review: Releasing The Research Imagination*, Sage.

Harvey, K. 2016. Feature Creep: What Causes It & How To Avoid It. *Chargify Blog* [Online]. Available From: Https://Www.Chargify.Com/Blog/Feature-Creep/ 2020].

Heinrich, C. J., Burch, P., Good, A., Acosta, R., Cheng, H., Dillender, M., Kirshbaum, C., Nisar, H. & Stewart, M. 2014. Improving The Implementation And Effectiveness Of Out-Of-School-Time Tutoring. *Journal Of Policy Analysis And Management,* 33**,** 471-494.

Hevner, A. R. 2007. A Three Cycle View Of Design Science Research. *Scandinavian Journal Of Information Systems,* 19**,** 4.

Hevner, A. R., March, S. T., Park, J. & Ram, S. 2004. Design Science In Information Systems Research. *Mis Quarterly***,** 75-105.

Iivari, J. & Venable, J. 2009. *Action Research And Design Science Research - Seemingly Similar But Decisively Dissimilar*.

Islam, R., Islam, R. & Mazumder, T. 2010. Mobile Application And Its Global Impact. *International Journal Of Engineering & Technology (Ijest),* 10**,** 72-78.

Jiang, Y., Zhang, C., Wu, D. & Liu, P. Feature-Based Software Customization: Preliminary Analysis, Formalization, And Methods.  2016 Ieee 17th International Symposium On High Assurance Systems Engineering (Hase), 2016. Ieee, 122-131.

Johnson, R. B. & Onwuegbuzie, A. J. 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher,* 33**,** 14-26.

Kabir, S. M. 2016. Methods Of Data Collection.

Kampas, P. J. 2003. Shifting Cultural Gears In Technology-Driven Industries. *Mit Sloan Management Review,* 44**,** 41-48a.

Karch, M. 2020. *A Beginner's Guide To Mobile Apps* [Online]. Available: Https://Www.Lifewire.Com/What-Are-Apps-1616114 [Accessed 31 August 2020 2020].

Koshy, E., Koshy, V. & Waterman, H. 2010. *Action Research In Healthcare*, Sage.

Lilljebjörn Rusk, M. & Ejlertsson, F. 2020. Design Of Pulsappen: A Mobile Healthcare Application To Make Administrative Work More Efficient For Caregivers.

Maccoll, I., Cooper, R., Rittenbruch, M. & Viller, S. 2005. Watching Ourselves Watching: Ethical Issues In Ethnographic Action Research. *Proceedings Of The 17th Australia Conference On Computer-Human Interaction: Citizens Online: Considerations For Today And The Future.* Canberra, Australia: Computer-Human Interaction Special Interest Group (Chisig) Of Australia.

Mccusker, K. & Gunaydin, S. 2015. Research Using Qualitative, Quantitative Or Mixed Methods And Choice Based On The Research. *Perfusion,* 30**,** 537-542.

Merriam-Webster 2020a. Automation. *Merriam-Webster.Com Dictionary.*

Merriam-Webster 2020b. Feature. *Merriam-Webster.Com Dictionary.*

Merriam-Webster 2020c. Functionality. *Merriam-Webster.Com Dictionary.*

Mischo, C. & Haag, L. 2002. Expansion And Effectiveness Of Private Tutoring. *European Journal Of Psychology Of Education,* 17**,** 263.

Mullarkey, M. T. & Hevner, A. R. 2019. An Elaborated Action Design Research Process Model. *European Journal Of Information Systems,* 28**,** 6-20.

Myers, M. D. & Venable, J. R. 2014. A Set Of Ethical Principles For Design Science Research In Information Systems. *Information & Management,* 51**,** 801-809.

Nah, F. F.-H., Siau, K. & Sheng, H. 2005. The Value Of Mobile Applications: A Utility Company Study. *Communications Of The Acm,* 48**,** 85-90.

Noyes, J. M. & Garland, K. J. 2008. Computer-Vs. Paper-Based Tasks: Are They Equivalent? *Ergonomics,* 51**,** 1352-1375.

Peffers, K., Tuunanen, T., Rothenberger, M. A. & Chatterjee, S. 2007. A Design Science Research Methodology For Information Systems Research. *Journal Of Management Information Systems,* 24**,** 45-77.

Pickton, M. 2013. Writing Your Research Plan.

Poetker, B. 2019. *What Are The Different Tyoes Of Mobile Apps?* [Online]. Learning Hub. Available: Https://Learn.G2.Com/Types-Of-Mobile-Apps [Accessed 31 August 2020].

Que, P., Guo, X. & Zhu, M. A Comprehensive Comparison Between Hybrid And Native App Paradigms.  2016 8th International Conference On Computational Intelligence And Communication Networks (Cicn), 2016. Ieee, 611-614.

Randolph, J. 2009. A Guide To Writing The Dissertation Literature Review. *Practical Assessment, Research, And Evaluation,* 14**,** 13.

Säfsten, K., Winroth, M. & Stahre, J. 2007. The Content And Process Of Automation Strategies. *International Journal Of Production Economics,* 110**,** 25-38.
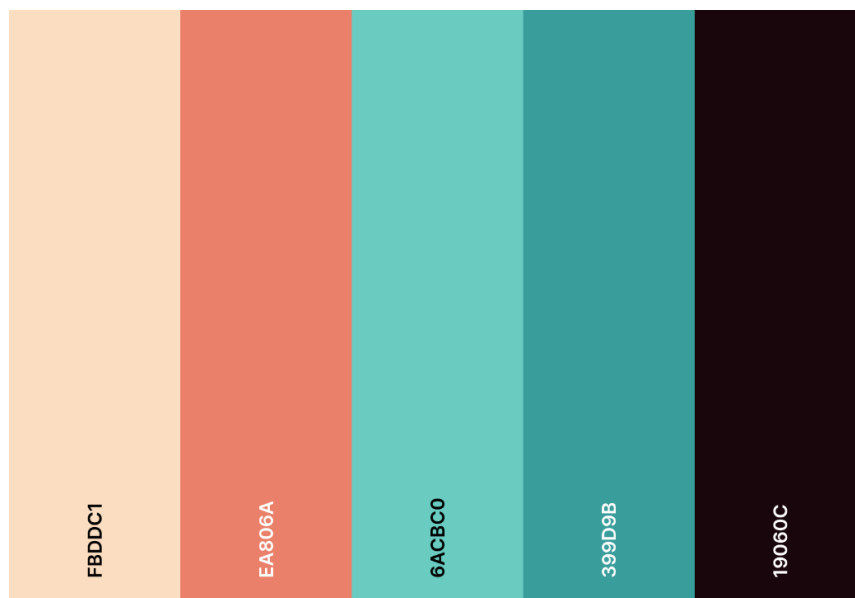
Saunders, M., Lewis, P. & Thornhill, A. 2011. Research Methods For Business Students. India. Pearson Education.

Sileyew, K. J. 2019. Research Design And Methodology. *Text Mining-Analysis, Programming And Application.* Intechopen.

Silverman, D. 2013. *Doing Qualitative Research: A Practical Handbook*, Sage Publications Limited.

Sofaer, S. 2002. Qualitative Research Methods. *International Journal For Quality In Health Care,* 14**,** 195-199.

Ssempala, M., Kabuunga, H., Taremwa, J. & Magero, T. 2018. Academic School Management Mobile Application.

Stringer, E. T. 2013. *Action Research*, Sage Publications.

Tacchi, J., Slater, D. & Hearn, G. 2003. Ethnographic Action Research.

Ter Hofstede, A. H., Van Der Aalst, W. M., Adams, M. & Russell, N. 2009. *Modern Business Process Automation: Yawl And Its Support Environment*, Springer Science & Business Media.

Terrell, S. R. 2015. *Writing A Proposal For Your Dissertation: Guidelines And Examples*, Guilford Publications.

Thomas, D. R. 2003. A General Inductive Approach For Qualitative Data Analysis.

Varshney, U., Vetter, R. J. & Kalakota, R. 2000. Mobile Commerce: A New Frontier. *Computer,* 33**,** 32-38.

Weber, S. Design Science Research: Paradigm Or Approach?  Amcis, 2010. 214.

Webster, J. & Watson, R. T. 2002. Analyzing The Past To Prepare For The Future: Writing A Literature Review. *Mis Quarterly***,** Xiii-Xxiii.

Wieringa, R. J. 2014. *Design Science Methodology For Information Systems And Software Engineering*, Springer.

Winchester, C. L. & Salji, M. 2016. Writing A Literature Review. *Journal Of Clinical Urology,* 9**,** 308-312.

Wood, D., Bruner, J. S. & Ross, G. 1976. The Role Of Tutoring In Problem Solving. *Journal Of Child Psychology And Psychiatry,* 17**,** 89-100.

Zhang, W. 2019. Regulating Private Tutoring In China: Uniform Policies, Diverse Responses. *Ecnu Review Of Education,* 2**,** 25-43.

# APPENDIX 1: INTERVIEW QUESTIONS

| Work routine questions | | |
|---|---|---|
| No. | Question | Type of Question |
| 1. | Are you a tutor, an office employee, or both? | Close-ended question |
| 2. | What are your responsibilities as this/these role(s)? | Open-ended question |
| **Tutor Questions** | | |
| No. | Question | Type of Question |
| 1. | Approximately how many students are in your class in each session? | Close-ended question |
| 2. | What is your routine from when a student arrives until they leave? | Open-ended question |
| 3. | Are there tasks in your routine that you feel could be easier, and if so, which tasks? | Open-ended question |
| 4. | Please describe how you know when which student is attending for class? | Open-ended question |
| 5. | Are you currently satisfied with this method? Is there a way you feel this could be easier? | Open-ended question |
| **Office Employee Questions** | | |
| No. | Question | Type of Question |
| 1. | What is your weekly routine as an office employee? | Open-ended question |
| 2. | Approximately how much time do the tasks in your weekly routine take up? | Close-ended question |
| 3. | What is your monthly routine as an office employee? | Open-ended question |
| 4. | Approximately how much time do the tasks in your monthly routine take up? | Close-ended question |
| 5. | Are there tasks in your weekly and monthly routine that you feel could be easier? | Open-ended question |
| **Mobile Application Questions** | | |
| No. | Question | Type of Question |
| 1. | Which of your tasks do you feel should be automated by the mobile application? | Close-ended question |
| 2. | Please describe how you think the task(s) should be represented by the mobile application? | Open-ended question |

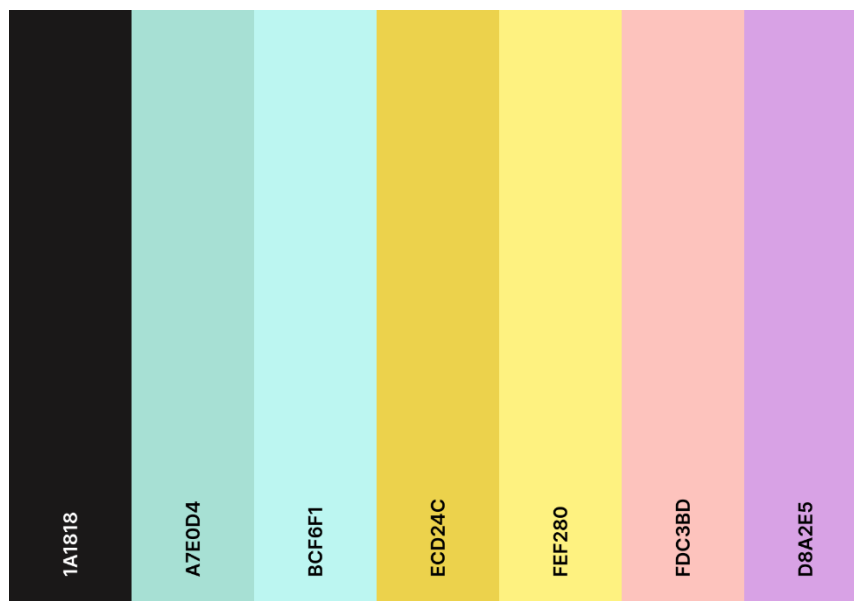| No. | Question | Type of Question |
|-----|----------|------------------|
| 3. | Which of these functionalities and/or features do you feel should be in the application?<br>o Role-based Functions<br>o Log in before making changes<br>o Record attendance of students<br>o Access student/ employee details | Close-ended question |
| 4. | What benefits would the development of such an application pose to the enterprise (as a whole)? | Open-ended question |
| 5. | What mobile devices are / should be used to run such an application? (iPad, iPhone, Samsung tablet(s), etc.) | Open-ended question |
| 6. | Does the enterprise have the infrastructure (internet connectivity, devices, technical know-how) to support such a mobile application? | Open-ended question |
| 7.1. | Would the enterprise be able to sustain and maintain such an application in the foreseeable future? | Close-ended question |
| 7.2. | Please elaborate on your answer in 7.1. | Open-ended question |
| 8. | Which of the following colour schemes (shown below) do you feel is suitable with regards to the interface?<br>o Theme A<br>o Theme B<br>o Theme C | Close-ended question |

Theme A



FBDDC1 | EA806A | 6ACBC0 | 399D9B | 19060C

## Theme B



000000  
666460  
9FAB9B  
EACDC7  
F9E8E2  
F6F6F6

## Theme C



1A1818  
A7E0D4  
BCF6F1  
ECD24C  
FEF280  
FDC3BD  
D8A2E5

76

# APPENDIX 2: CONSENT FORM

**TITLE OF THE RESEARCH STUDY:** Developing a mobile application for a tutoring enterprise by way of feature investigation.

**ETHICS REFERENCE NUMBERS:**

**PRINCIPAL INVESTIGATOR:** Natalie Liani Nilsson

**CONTACT NUMBER:** 064 685 2374

You are being invited to take part in a **research study** that forms part of my dissertation. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is **entirely voluntary,** and you are free to say no to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now.

## What is this research study all about?

The goal of this study is to develop an event-based mobile application for a tutoring enterprise in Vanderbijlpark. The mobile application will contain features and functions as determined by the participants.

## What is the data collection method?

Data will be collected with individual interviews with the participants of this study. A group of four to five employees at the tutoring enterprise will be chosen as potential participants.

Declaration by participant

By signing below, I ………………………………..…………. agree to take part in the research study titled:……………………………………….………………………………………..

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.

- The research was clearly explained to me.

- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.

- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.

- I may choose to leave the study at any time and will not be handled in a negative way if I do so.

- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ...................…........…………….. on (*date*) …………....………. 20....

.................................................................

**SIGNATURE OF PARTICIPANT**

## APPENDIX 3: FULL TRANSCRIPTS OF THE INTERVIEWS

| | **Work routine questions** | | | | |
|---|---|---|---|---|---|
| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
| 1. | Are you a tutor, an office employee, or both? | "Both." | "I am a tutor." | "I am a tutor for the enterprise." | "A tutor." |
| 2. | What are your responsibilities as this/these role(s)? | "I have to complete admin and HR-functions and give mathematics, accounting and economical business studies class." | "I give maths to Grade 11 Students" | "I give mathematics in English to a grade 8. I am also training to take on EMS for grade 8s." | "I have to ensure that I am up to date with upcoming tests or exams for our learners, confirm of my schedule. I have to stay up to date of the different methods for various topics – some schools have a variety of different methods for each module and give mathematics class using the appropriate method." |

| | **Tutor Questions** | | | | |
|---|---|---|---|---|---|
| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
| 1. | Approximately how many students are in your class in each session? | "1 to 5 learners." | "I have a few classes but mostly it is one-on-one, but I have one group of 3." | "I have one student at a time when I give class. I only have one student in general." | "I have 1 to 2 learners per class." |

| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
|---|---|---|---|---|---|

| 2. | What is your routine from when a student arrives until they leave? | "Upon arrival, I work through the COVID checklist with them, take their temperature and sanitize both learner and my hands. I then request that the learner collects his/her book and file from the bookshelf. I collect the previous weeks' homework and mark whilst the learner completes a quick warmup exercise. I then explain the mistakes made by the learner on homework – if any. I also ask the learner the following questions: 'Do you have any homework which you are struggling with now?', if yes, I assist learner with the homework. 'Do you have any exams / tests coming up?', if yes, copy the relevant units in terms of the demarcation. I copy homework and give it to the learner after the session. I ask the learner to sanitize his/her workspace and sign the learner out by taking his/her temperature. Lastly, I complete my timesheet." | "I try to arrive 15 minutes earlier to prepare, like print the work I would do with them. When they arrive, I would sign them in by taking their temperature and let them fill in the COVID forms then I would lead them to the class, and we will have class. I would then proceed to give class until the hour and a half is up. While they are packing up, I would go a fetch the sanitizer and paper towels so that we can clean their table and chair, thereafter I would sign them out and bid them a goodbye. Then I would clean up my workspace and sanitize everything I used, fill in my timesheet and sign out. Then I would be on my way home." | "Firstly, I will make sure all their things are ready in the classroom before I sign them in. When they arrive, I will help them with sanitizing their hands, taking their temperature, and answering the questions that are needed due to COVID. We will then go to class where I will teach them the material for the day and provide them with homework.  When my lesson is finish, I will first ask them if they have any topics, they would like for me to revise on for the next class. When it's time for them to leave, I will take their temperature and ensure they sanitize their hands again. Once they have left, I will record their times into my schedule and then proceed to sanitise the classroom and everything that was used." | "When the student arrives, I go through the through the COVID checklist with them, take their temperature and sanitize their hands. I then ask them to collect their book. I give class by revising any homework they might be struggling with and discuss the topic they are busy with at school. I print homework and give it to learner. I ask them to sanitize where they worked, and I take their temperature to sign them out. I then complete my timesheet to record the attendance of the learner." |

| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
|---|---|---|---|---|---|
| 3. | Are there tasks in your routine that you feel could be easier, and if so, which tasks? | "Completion of my timesheets. I sometimes forget to fill out my timesheet for 5 days, and then it is a real struggle to complete it after so much time. This results in parents not being charged for sessions. It is very time consuming to remember to complete my timesheet." | "I do not think so I quite like order, and everything has order, therefor I cannot complain." | "No, I am very much satisfied with how my tasks flow and find no difficulty when doing them." | I wish there were an easier way to complete my timesheets, since I sometimes forget to fill out my timesheet then the office employees have to consult me to fill in the missing values." |
| 4. | Please describe how you know when which student is attending for class? | "One of the office employees sends a schedule via WhatsApp and one is provided on the wall. When changes occur the office, employee notifies us the moment the change occurs." | "An office employee and I would set out my schedule for the week, therefor I know who attends where and how late. If any cancellations are to occur, they would let me know in the form of a WhatsApp or a call. Sometimes they would tell me when they see me the prior day." | "Our schedules are usually sent to us before the week starts or majority of our students have a set time and day of the week for when their class takes place and if it changes, we find out in advance. The week's schedule is also posted on the pinboard for everyone to see." | "We receive a schedule beforehand that is send to us on WhatsApp. We are also notified on WhatsApp if the schedule changes." |

| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
|-----|----------|---------------|---------------|---------------|---------------|
| 5. | Are you currently satisfied with this method? Is there a way you feel this could be easier? | "Sometimes the office employee forgets to notify us. Yes, if there is a fixed schedule where parents have to confirm their booking 24 hours in advance via a math app. The app should allow parents to book their lessons in the spaces available, the office employee needs to approve the booking before it can happen. The app should also notify tutors immediately of all the changes made to the schedule. Also, when a student arrives or cancels a class, the tutors should be able to note this change on the app." | "Yes, I am satisfied. Maybe if we could communicate with the students personally, but I do understand the protocol set in place to not communicate with the students individually." | "Yes, I am currently satisfied with the way the scheduling is made available to us." | "The method works as best it can. If there is a fixed schedule, learners or tutors can sign in and it automatically shows on our timesheet and schedule." |

| **Office Employee Questions** | | |
|---|---|---|
| No. | Question | Participant 1 |
| 1. | What is your weekly routine as an office employee? | "I open up the office every morning and sanitize all surfaces. I confirm the daily schedule with parents and respond to WhatsApp's send the previous day. I schedule learners for additional sessions as per their tests/assessments and make necessary adjustments to accommodate all the learners on a weekly basis. I also consider if any goods need to be purchased for the week – stock check. I review prior week's timesheet and make copies of the timesheets. I do weekly preparation for learner's tests and make copies of prior exams for practice for all tutors. I check the printers to see if the printers have sufficient paper and ink and I do a clean cycle on the printers. I print out weekly schedules and put them up on the walls. I also notify tutors of any changes. I also follow up on any discrepancies in the statements and long-overdue tuition fees. Then I lock up." |
| 2. | Approximately how much time do the tasks in your weekly routine take up? | "It takes 4 to 6 hours daily – sometimes includes weekends. 28 hours weekly on average" |
| 3. | What is your monthly routine as an office employee? | "Monthly I email statements, calculate monthly wages and perform payments of tutors, cleaning staff and others. I reconcile expenses which occurred during the month. Lastly, I plan schedules and notify tutors and parents via WhatsApp." |
| 4. | Approximately how much time do the tasks in your monthly routine take up? | "16 to 24 hours in the course of 3 days at the end of the month." |
| 5. | Are there tasks in your weekly and monthly routine that you feel could be easier? | "Scheduling learners and notifying parents and tutors, as well as reconciling expenses and constructing statements" |

| **Mobile Application Questions** | | | | | |
|---|---|---|---|---|---|
| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
| 1. | Which of your tasks do you feel should be automated by the mobile application? | "Planning and scheduling of learners. Automated statements generation function" | "Truly I do not know. I actually like the paper base idea we are working with but if I should identify something it would be the attendance, it could be electronical because we usually need to try and find our papers at the end of the class, it is quite time consuming." | "I wouldn't mind if the timesheets and our duties were put on a mobile app so that it could be less time consuming." | "Automatic generated timesheet" |
| 2. | Please describe how you think the task(s) should be represented by the mobile application? | "Every time a learner is scheduled the application should automatically bill the parent for the hour(s), the function should allow a parent to schedule the preferred time weekly – repeat function." | "For example, each tutor has their own attendance forms on the device and just type in their students name in and full in the information as they enter." | "I would prefer the same format that it is currently but just made available for an application" | "Every time a learner is scheduled the application should generate an on-screen timesheet with the already existing name of learner. When the learner attends, we can just select from a drop-down list." |
| 3. | Which of these functionalities and/or features do you feel should be in the application?<br>o Role-based Functions<br>o Log in before making changes<br>o Record attendance of students<br>o Access student/ employee details | "There should be role-based functions, log in before making changes, and recording of attendance of students." | "All of the options should be available" | "All of the options." | "Role-based Functions, log in, and record attendance of students." |

| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
|---|---|---|---|---|---|
| 4. | What benefits would the development of such an application pose to the enterprise (as a whole)? | "It would be time saving." | "I think it would spare us a few minutes that we can use to communicate with our students." | "It would be less time consuming as well as provide more efficiency and accuracy" | "It would save us a lot of time." |
| 5. | What mobile devices are / should be used to run such an application? (iPad, iPhone, Samsung tablet(s), etc.) | "Any tablet or Android device or pc that allows for integrated pen function if the owner should authorize something they can sign." | "I do not have a preference, I would suggest what we have like a cell phone, but we would have to bear with the risk of it getting broken or stolen." | "Any Android device." | "Any tablet or Android device that is portable and durable." |
| 6. | Does the enterprise have the infrastructure (internet connectivity, devices, technical know-how) to support such a mobile application? | "Yes." | "Yes." | "Yes, I am quite sure all the employees have a basic understanding of how technology works." | "Yes." |
| 7.1. | Would the enterprise be able to sustain and maintain such an application in the foreseeable future? | "Yes and no." | "Yes" | "I am unsure, but it is possible" | "Yes, for the enterprise." |

| No. | Question | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
|-----|----------|---------------|---------------|---------------|---------------|
| 7.2. | Please elaborate on your answer in 7.1. | "Maintaining such an application would give rise to IT expenses not yet considered when costing / budgeting.  It may become too expensive and learners will have to pay more, which is not ideal.  Many of the application functions would still require human intervention, although it would be time saving, it would give rise to other administrative duties which would require time." | "We are mostly students working at this institute, therefor we make use of technology daily and we would be up to date with changes, we are used to working with technology therefor it just makes sense that we will be able to sustain and maintain." | "It is possible for the company to sustain and maintain this future of technology although it does come with risks though." | "The enterprise has the infrastructure to sustain the system, but I am not very computer literate and will have to receive training on how to use the technology." |
| 8. | Which of the following colour schemes do you feel is suitable with regards to the interface?<br>o Theme A<br>o Theme B<br>o Theme C | "Theme B." | "Theme A." | "Theme A." | "Theme C." |

# APPENDIX 4: PLAGIARISM DECLARATION

*To be Attached

# Design and Technical Documentation

## NL Nilsson
## 28585828

Design and Technical Documentation for the Dissertation submitted in *partial* fulfillment of the requirements for the degree *Baccalaureus Scientiae Honours* in Information Technology and Computer Science in at the North-West University

Supervisor:          Mr. L Bunt

Date of submission:          30 November 2020

Version:          1.0

# TABLE OF CONTENTS

# TABLE OF FIGURES

# LIST OF TABLES

# DESIGN AND TECHNICAL DOCUMENTATION

## 1   Introduction

In this document the design and initial development of an artefact prototype will be discussed. The artefact is a mobile application that should automate administrative and scheduling tasks for a tutoring enterprise. The next part of the document describes the rationale of the artefact. This describes why the artefact was developed, what the artefact is and what the goal of the artefact is. Furthermore, the design and development process that was followed will be explained. Due to various limitations, not all the user feature requests can be fulfilled. These features will be listed. Lastly, a user guide will be provided. The aim of the user guide is to inform the reader on how to install and use the artefact and where they can find support if they experience problems.

## 2   Rationale

This document accompanies an empirical study called "Development a mobile application prototype for a tutoring enterprise by way of feature investigation". The empirical study consists of four components. The first component of the empirical work is the introduction where the research problem was defined, the research objectives and questions were listed and where the aim of the study was discussed. The research problem was that employees at a primary and secondary school tutoring enterprise struggle to complete all their administrative tasks since these tasks are time consuming, this has caused a decrease in the enterprise's efficiency. The enterprise hopes to have way that these tasks can be automated with some type of software or application. To solve this problem, a goal for the study has been set in place. This goal was to develop a mobile application that should automate the tasks for the enterprise.

The second component of the empirical study involves providing a research plan that was followed by the researcher. In this research plan the methodology and paradigm that forms part of the study was discussed as well as the data collection and analysis methods that was used. The methodology was an action design science coupling and the paradigm was qualitative. Using an action design science methodology allowed the researcher to develop an artefact that solved a unique problem. The qualitative paradigm means that the researcher approached the study with the mindset that the perceptions, experiences, and opinions of the participants are very important. Furthermore, it was determined that the qualitative data was collected with interviews and analysed by using content analysis with open coding.

Before the data could be collected and analysed, the researcher reviewed existing literature – the third component of the study. There are two main pieces of information that was collected from the literature review. The first piece of information was to determine what questions should be asked in an interview to ensure that the researcher has enough data to determine what the

application should contain, look like, and do. The second piece of information was to determine what features and functionalities are usually included in administrative and scheduling applications for tutoring enterprises.

The last component included collecting and analysing data by using the predetermined methods. Data was collected from participants by means of personal interviews. The data gathered from the interviews were transcribed and analysed with content analysis and open coding. The analysis revealed the features and functions that the participants feel should be included in the mobile application, if they feel the application will benefit the tutoring enterprise and what device they think the application should be developed for. By determining what features and functions the participants need in the mobile application and what device they prefer, the development of the mobile application prototype could commence.

As mentioned earlier, the empirical study requires the researcher to develop an artefact. The artefact is a mobile application prototype and the goal of the mobile application is to automate administrative and scheduling tasks that are performed by the employees at a primary and secondary tutoring enterprise. The administrative tasks include processes such as logging the attendance of students, informing the tutors of which student is scheduled when, and generating statements for each student based on the attendance of the student. An authorised user should also be able to schedule a class for a new or existing student.

The mobile application contains role-based access control for added security and to prevent accidental or intentional misuse. The features and functionalities that should be included in the mobile application have been determined by interviewing various participants that are employees at the tutoring enterprise. The color scheme of the mobile application was also determined with the interview and was used during the design of the mobile application. The mobile application will be used daily by the tutoring enterprise. The mobile application hopes to make the enterprise more efficient and accurate while saving the employees time.

## 3   Design and development process

The empirical study set a methodology in place that was followed during the development of the mobile application. This methodology is action design science research and consists of 5 activities that form part of the life cycle of artefact development. Although the life cycle consists of five sequential activities, the study has taken a design and development centered design and will start the life cycle at activity three – design and development of the artefact. Another variation in the life cycle order was that user requirements and features was determined before the development started instead of after.

The design and development process that was followed is listed below:

1. **Requirements gathering**: Determine the business, functional and technical requirements. This is partly done in the data collection and analysis component in the empirical study.
2. **Initial design**: Design the interfaces for the primary functions.
3. **Prototype development**: Develop the prototype and add interfaces as technical requirements are developed.

## 3.1 Requirements gathering

It is very important to gather all the requirements when a project starts. Requirements gathering guides the project team as to what should be done in the project and what results should be expected from the development process (Vega, 2018). Three main categories of requirements will be addressed, these include: business requirements, functional requirements, and technical requirements. It is also worth mentioning features that will not be included in the prototype due to constraints such as limited time, lack of coding knowledge, absence of project team members that are developers, and limited resources.

### 3.1.1 Business requirements

The business requirement is concerned with what artefact the business wants or needs in order to achieve a certain goal or objective (Garima, 2019). As stated in the name, the business requirement is written from the business' perspective. The table below shows the business requirement(s):

**Table 5.6-1: Business requirements**

| Requirements Description | Priority |
|---|---|
| The enterprise needs a mobile application to be developed that will automate their administrative tasks and therefore save the employees valuable time while also making the enterprise more effective. | High |

### 3.1.2 Functional requirements

The functional requirements of a project describe how the business requirements will be achieved by referring to the functionalities that will be included in the artefact and should be written from the point of view of the artefact (Garima, 2019). Accomplishing the functional requirements will provide the enterprise with the solution they needed (Garima, 2019). The functional requirements for this project have been determined during the data collection and analysis component of the empirical study and can be found in the table below:

**Table 5.6-2: Functional requirements**

| Requirements Description | Priority |
|---|---|
| The mobile application should automate the scheduling process by allowing users to simply choose an available class for the student and then booking that class for the student. | High |
| The mobile application should automate the generation of statements by allowing the user to choose the student they wish to compile a statement for and then automatically generating the statement based on the attendance of the student. | Medium |
| The mobile application should automate the attendance logging process by allowing the user to see the student that should be at the class at that moment and then they should choose whether the student attended, did not attend or cancelled the class. | High |

### 3.1.3   Technical requirements

Technical requirements, often referred to as non-functional requirements, refer to requirements that was not explicitly asked for by the users but is needed to accomplish the functional requirements, add better usability of the artefact, or enhance security (Ambler, 2004:24). Like functional requirements, technical requirements are written from the point of view of the artefact. The technical functionalities applicable is this project is shown in the table below:

**Table 5.6-3: Technical requirements**

| Requirements Description | Priority |
|---|---|
| The mobile application should display the scheduled classes in an easy to read manner. Information regarding the scheduled class should also be displayed such as the day and time of the class, the student's subject, the tutor that will give the class and the student's grade and school. | High |
| The mobile application should have role-based access control for functions such as scheduling a class, recording the attendance of the student, and requesting statements. | High |
| The mobile application should store the data pertaining to scheduled classes (such as the time, student attending for class, etc.) and attendance of classes. | High |
| The mobile should be developed to be compatible with *Android* devices, preferably a tablet. | Low |
| The Graphical User Interface (GUI) should have a logical flow and a color scheme that would suit the users. | Low |

### 3.1.4    Non-goal requirements

Since the goal of this project is to develop a prototype, some features will not be included in the artefact. Some limitations exist with regards to the development of the artefact, these limitations include, but are not limited to:

- Insufficient knowledge of coding mobile applications, which leads to the next limitation.
- Strict time frame for the completion of the prototype that did not allow for room to learn and explore coding.
- There is no project team that can focus on different parts of the development process and therefore one member must complete all the duties in the artefact development life cycle.
- There is a lack of funding for more advanced development tools. The software that was used for development has limited functionalities for no cost. Some of the functionalities that will be needed in the actual development of the artefact will require funding to be included.

With the above limitations, the following features are not included or only somewhat developed in the mobile application prototype:

- Users can schedule classes but only with a duration of one hour. All the classes also start on the hour (i.e. 14:00) where the first class starts at 2:00 p.m. and the last class starts at 7:00 p.m.
- Sensitive information of students and employees (such as contact number or address) cannot be accessed and is not stored by the mobile application.
- Users can schedule classes for existing or new students, but their information must be entered regardless of if they are new or not. Classes cannot be changed or deleted for an existing student.

### 3.2    Initial design

A vital task that should be completed in mobile application development process is the design of the graphical user interface (GUI) (Galitz, 2007:3). The interface is the first thing users will see and they will use this to complete the functions they required. A poorly designed GUI will make users frustrated and consequently stop using the application (Galitz, 2007:3). Designing a GUI consist of three main steps (Wieringa, 2014:27). The first step is to describe the problem and determine the core functionalities that should be included in the of the mobile application. The second step is to use the functionalities and create a user interface design. The last step is to describe how the design contains the necessary functions. These steps will now be followed to design the GUI for the mobile application.

There are three core functions that the mobile application should contain, these three functions are listed below:

- Schedule classes for students. Authorised users should be allowed to add students and classes for the new or existing students.
- Automate the tutor's timesheet. The user should be able to log the student's attendance, they could either attend, not attend, or cancel a class.
- Automate the generation of the statements. At the end of the month, an authorised user should be able to select a student for which a statement must be generated based on their attendance. On a separate device this statement will be sent to the person responsible for the account.

Step 2 and 3: Create GUIs for each of the core functions and show that it contains the necessary functions

GUIs have been created for each function that will visualize the process that must be completed. The first GUI design was created for the scheduling of the classes and can be seen below.



**Figure 5.6-1: Graphical user interface for scheduling of a class**

The next figure will show the design for the second core function, which is the function that allows users to log the attendance of students.
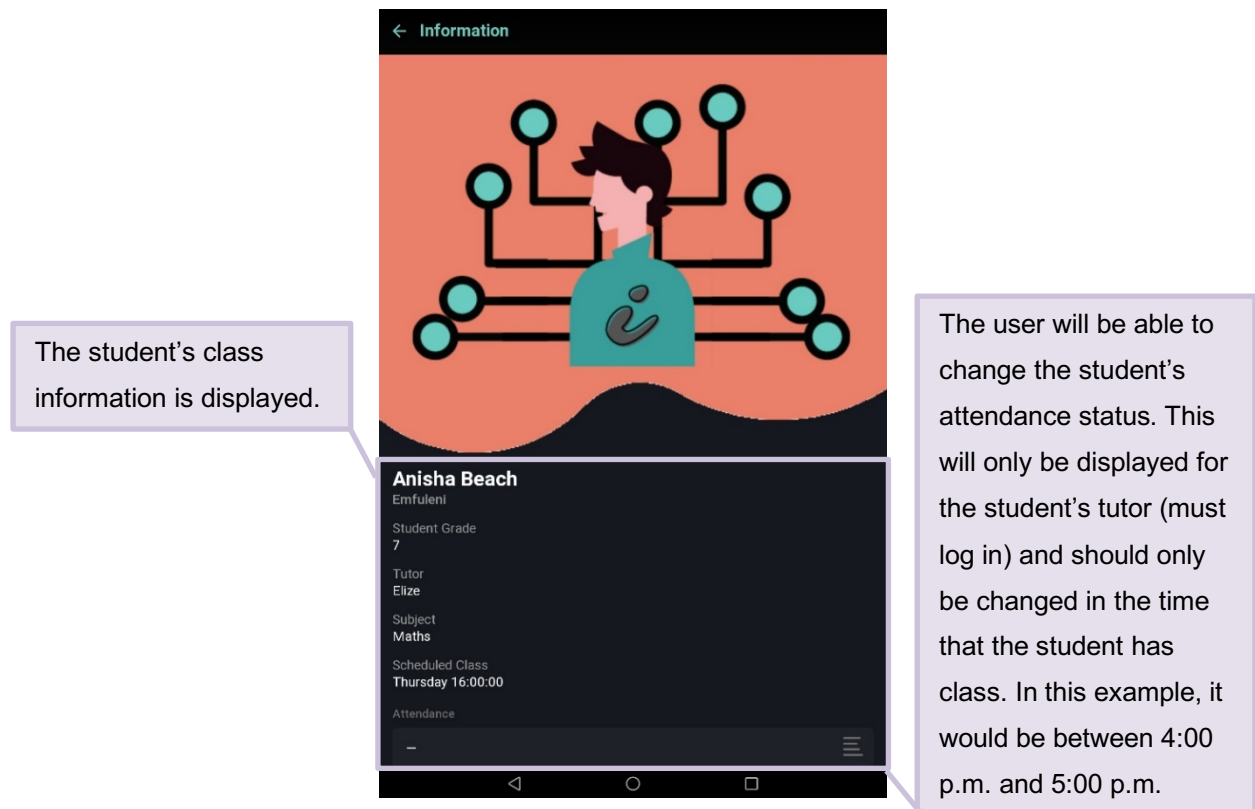
The student's class information is displayed.

The user will be able to change the student's attendance status. This will only be displayed for the student's tutor (must log in) and should only be changed in the time that the student has class. In this example, it would be between 4:00 p.m. and 5:00 p.m.

**Anisha Beach**
Emfuleni

Student Grade
7

Tutor
Elize

Subject
Maths

Scheduled Class
Thursday 16:00:00

Attendance

**Figure 5.6-2: Graphical user interface for logging of attendance**

The last core function includes the automatic generation of statements based on the student's attendance. The user interface design for this function can be seen below.

The user will be able to press the button to start the statement generation process that will then be stored on the user's cloud storage service.

The user will be able to choose a name from the list. The statement will be generated for this student.

**Statement Request**
Request the statement of one student. It will be saved to Google Drive.

Choose a student:

Imogen Cordova

Required

Please give a minute wait time.

GET STATEMENT

**Figure 5.6-3 Graphical user interface for the generation of a statement.**

A GUI has been designed for each core function in the mobile application. The development of the mobile can now commence.

### 3.2.1 Prototype development

Various factors were considered before the development of the mobile application prototype started. It is necessary to first determine what development software or platform will be used to develop the prototype. The application will store data that related to the scheduled classes, the students that attend class and other information that is needed to complete the core functions. Therefore, the data storage software should also be discussed. The development software and storage software should be able to send data between then easily, meaning the software should be compatible with each other.

As the coding starts, it is necessary to define what language the coding will be, what naming and coding conventions will be used for variables, functions, etc. The coding best practices that was used should also be listed to ensure that other developers can understand the code if they need to adjust the code in the future. The testing process that was followed will also summarized.

### 3.2.2 Development Software Specification

In this project the mobile application was only developed as a prototype. For this reason, *Glide* was used to develop the prototype. *Glide* is a service, a web application, that allows users to develop a mobile application from a *Google Sheets* spreadsheet without writing any code (Miller, 2019). The application that is developed with *Glide* is a progressive web application and can be used on any device (*Windows* computer, *Mac* computers, *iOS*-, *Android*-, or *Windows* phone or tablet) with an internet connection (Raphael, 2020).

While most of the functionality was completed in Glide, some coding was necessary on the Google Sheets spreadsheet's side. *Google Apps Script* was used to add custom functions to the spreadsheets. *Google Apps Script* is a rapid application development (RAD) platform that can be used to code in Server Side JavaScript (SSJS) on the server-side but HTML, CSS, or JavaScript code can be added and run on a browser (Collins, 2019).

### 3.2.3 Data Storage

*Google Sheets* spreadsheet was used as the method of storing data since *Glide* uses *Google Sheets* spreadsheets as the origin of data that is used in the application. *Google Sheets* spreadsheets are hosted online (cloud-based).

### 3.2.4 Coding standards and naming conventions

Coding standards and naming convention set a foundation for all code, this allows various developers to look at code that they have never seen before and take very little time to understand what the goal of the code is. The table below will summarise the coding standards that was used in *Google Apps Script.*

**Table 5.6-4: Standard coding rules**

| Coding Aspect | Standard Rule |
|---|---|
| Comments | Enclosed in /** */ for block comments or // for line comments |
| Indentation | Indentations are not made with the Tab character. Indentations are made with two space characters. |
| Control structures | Braces () are used with control structures ("if-else", "for", "do-while") |
| Nonempty blocks (a block of statements that forms part of a function) | Egyptian brackets ( { } ) are used for nonempty blocks and block structures. Some rules exist for the use of these brackets:<br>− There should not be a line break **before** the first brace.<br>− There should be a line break **after** the first brace.<br>− There should be a line break **before** the last brace<br>− There should be a line break **after** the last brace unless it is followed by "else", "catch" or "while" |
| Arrays | An array can be coded in block like manner or it can be in one single line. The values of the array must be enclosed in block braces ( [ ] ). |
| Functions | Function names are in lowercase. Arguments of the function should be enclosed in braces (). The body of the function should follow the indentation rule. |
| Statements | There should be one statement in each line, and it should with a semicolon (;) |
| String literals | Use single quotes (' ') for strings rather than double quotes (" ") |

A specific naming convention should be used for all identifiers. This naming convention was also followed in the naming of columns in the *Google Sheets* spreadsheet.

The naming convention states that:
- all identifiers should have a descriptive name that accurately represents the goal of the identifier.
- identifiers should be in lowercase and can consist of ASCII letters and digits.

- if the identifier consists of more than one work, the words can be separated by underscores (_) or the words can be formatted in camel case meaning each added word is capitalised. Example:
  - o if the identifier is employee ID, it can be written as employee_id (separated by underscore and lowercase) or employeeId (camel case).

### 3.2.5 Programming Practices

Common coding practices are used for the same reason coding standards and naming conventions are used – to make the code easier to read and understand for other developers that might need to change or access the code. Below is a list of general programming practices that was followed in the development of the mobile application.

1. The code should have a consistent indentation style. As discussed earlier, the code will be indented with two space characters. This will be repeated in code blocks.
2. Code should be recycled. The code should not be repeated each time a certain function is performed, one piece of code should rather be used many times.
3. Deep nested code should be avoided since it can be heard to read.
4. Use the naming conventions that are set out in the documentation.
5. Avoid long lines of code since this can make the code look messy and hard to read.

### 3.2.6 Initial Testing

The mobile application is a prototype and will not implemented in the enterprise for full evaluation and testing. The functionalities along with the look-and-feel of the application were tested. Since the artefact is a prototype, not all the functionalities are optimal, but they do what they are intended to do.

## 4 User guide

This user guide will provide background information on the mobile application and provide you with the tools you need to use the mobile application. The mobile application prototype is used to aid employees at a tutoring enterprise by automating their administrative and scheduling tasks. This mobile application will be used in an office environment by the employees. The installation process will be described. Instructions will also be provided to help you understand how to use the mobile application. Sources of support will also be provided; you can refer to this if you struggle with any of the instructions. The suitable devices and user specifications of the application will be mentioned. The tasks that can be performed with the application form part of the features and functionalities of the application. The functions and features of the mobile applications are tabulated below.

| Functions | Features |
|---|---|
| The application automates the scheduling of students by allowing the user to enter the student information where after the application provides the user with various available classes that can be chosen. | Office employees have access to a list of all the students that attend class at the enterprise. This list can be sorted by name, grade, and school and the user can also search. |
| The mobile application automates the tutor's timesheet by providing the scheduled student's information and the user simply must choose if they attended, did not attend, or cancelled. | The mobile application provides the user with a calendar and list view of all the scheduled classes making it easy for users to see which student is attending what class and at what time. |
| The mobile application can automatically generate statements once the user has chosen a student that they want a statement for. | Some applicable graphics have been added to some of the screens as eye candy and to help the user immediately identify what the purpose of the page is. |
| | Users can see non-sensitive information about each student including their:<br>- name and surname<br>- grade<br>- school<br>- subject<br>- class time |
| | A suitable color scheme (as determined through the empirical study) has been applied to the mobile application. |
| | The mobile application provides the user with a calendar and list view of each tutors' scheduled classes. |
| | There is a search function in the calendar and list view screens. Users can search by student name, grade, class, and more. |
| | The mobile application offers role-based access control by allowing users with a certain role to access functions other users cannot. |

## 4.1 How to install the mobile application

The steps below will provide instructions to install the mobile application.

Installation link: https://resolute-soup-4166.glideapp.io/

Installation QR code:

**Step 1:** On your phone, open the browser (option 1) OR open your camera (option 2).

Option 1 – Enter the hyperlink

It is suggested to use Chrome browser for your Android device.

a. Once your browser is open, enter the link into the search bar and press search.

Option 2 – Scan the QR Code

If your phone cannot scan QR codes through the camera, it is better to try option 1.

a. Once the camera successfully identifies the QR code, click on the link provided.

**Step 2:** Add the application to your home screen.

This is known as *Add to Home screen* (A2HS).

a. Once the site is loaded, you might see an install pop-up banner that will ask you if you want to add the app to your home screen.
    o Click on this banner.
    o The application will successfully be installed to your device.
b. If you cannot see this banner, you must manually add the application to your home screen.
    o Click on the three dots at the right of the screen.
    o Click on 'Add to Home Screen'
    o The application will successfully be installed to your device

### 4.1.1   Instructions for use

There are two user roles that use this application: admin (office employees) or tutors. Most of the instructions are similar for both roles, but admin roles have access to more functions than tutors. This user guide will only show the instructions that should be followed to complete the function of recording a student's attendance and acts more as an example of use rather than a full explanatory instruction manual. It is important to mention that the screenshots do not always match the logical flow, this is because some content cannot be accessed at without meeting certain conditions.

**Action 1:** Open the application.
Click on the app on your home screen.
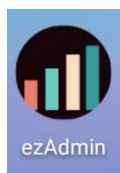


Once the application has loaded, you will see a list of all the students that are scheduled for class. It will look like the photo below.
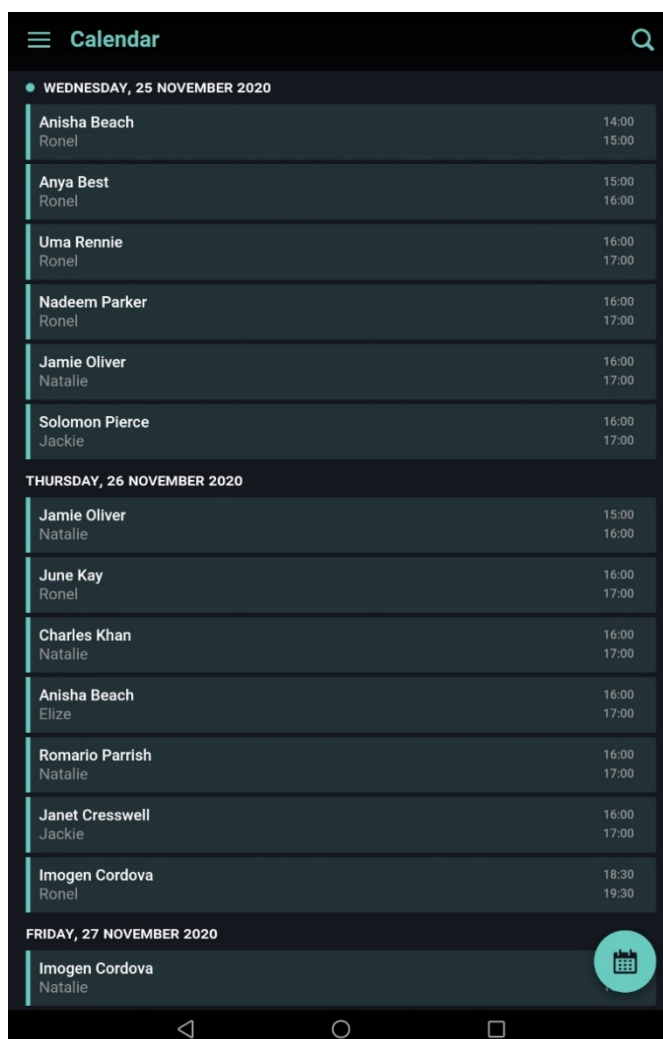
From this screen you can take any of four directions.

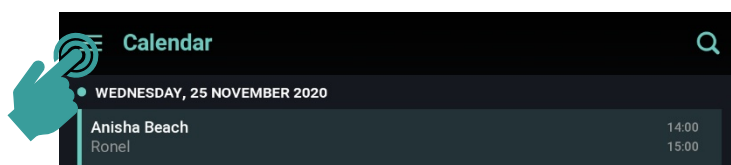- You could click on one of the names that is currently on the screen.
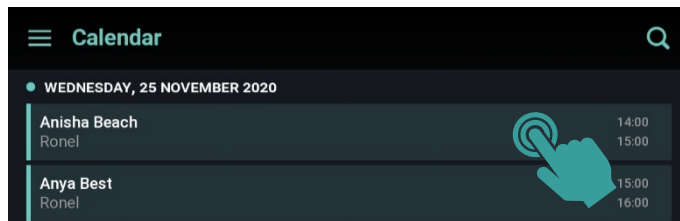


- You could click on the little calendar icon on the bottom right of the screen.



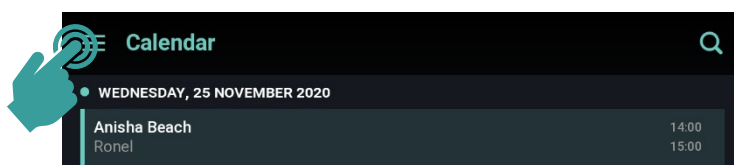- You could click on the magnifying glass at the top right of the screen.



- You could click on the hamburger menu at the top left of the screen.



**Action 2:** Report the attendance of a student.

From the initial screen, click on the hamburger menu at the top left.



You should sign in first. You will be required to enter your name and employee email. Once that is finished you need to wait for a one-time pin (OTP), which you need to enter. You will then be signed in. Click on the hamburger menu again and then click on your calendar.
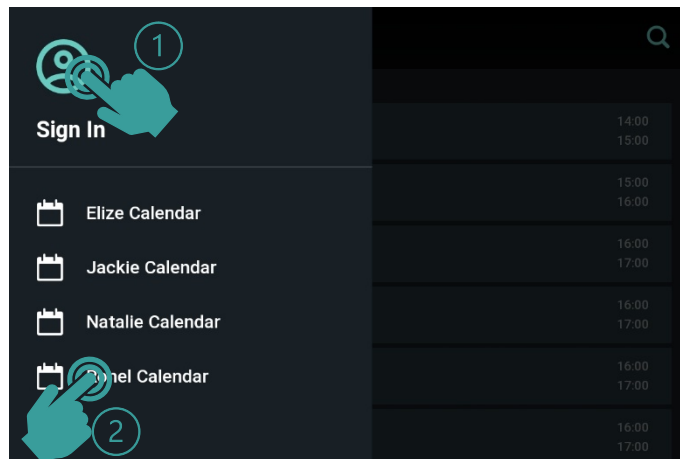
Once your list of classes appears, click on the student whose attendance you wish to record.
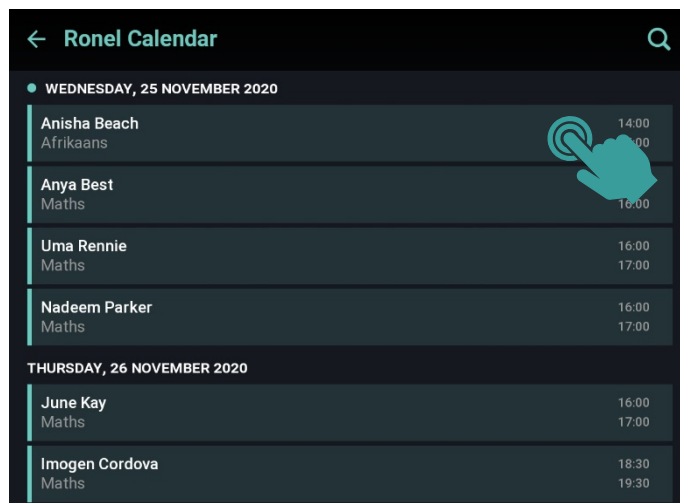




Please note that you will only be able to log the attendance of the student if you are logged in, it is your student, and it is currently their class time.

On the student info screen, you will see some information about the student and right at the bottom there is a box that you can click on. This is where you will log the student's attendance.
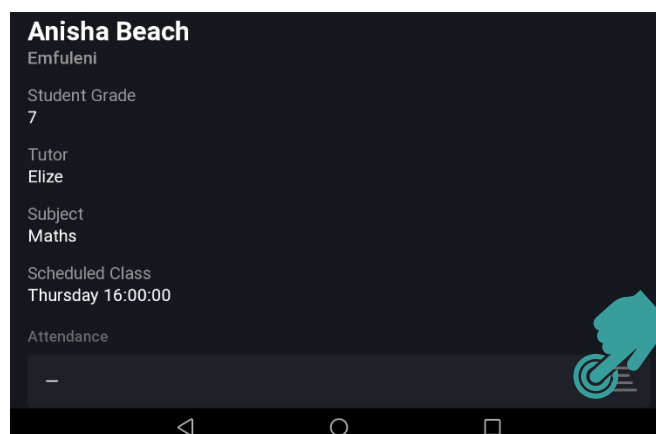
The screen now shows three choices, you can either select that the student did attend, the student did not attend, or they cancelled their class.
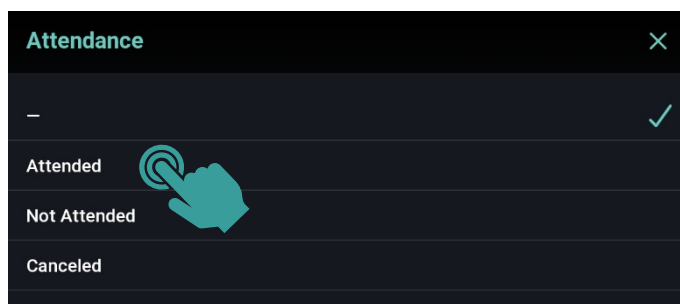


Once you clicked the choice you want to, the attendance of the student will be set.

### 4.1.2 Get support

If you have any trouble installing or using the application, you can refer to the support below.

**Where can I get help if something does not work?**

If you are struggling with something and the answers in the frequently asked questions section below cannot help you, please send an email to 28585828@student.g.nwu.ac.za, along with a question you would like answered or the description of your problem.

**The information is not loading, what now?**

It takes a while for information to load between the data storage service and the application, always allow a couple of seconds for changes or information to load. If waiting did not solve your problem, exit the application and re-open it.

**I did not receive my One-Time Pin when I logged in. What should I do?**

Please be sure to check your spam email folder for the email as the email is sometimes declared as spam.

**Why won't the application do anything when I open it?**

Firstly, check that you have an active internet connection. Since the application is a web application, it always needs to have an internet connection. If this still does not work, close the app, and clear it from your RAM. This can be done by clicking the square on the navigation bar (right at the bottom of the screen) and swiping the app either upwards or side wards.

**I found a bug, where should I report it?**

Please report any bugs to 28585828@student.g.nwu.ac.za along with a screenshot of the bug and a description of what you were doing on the app when you experienced the bug.

# 5 Conclusion

This design document contains information about the design and development of an artefact and also how the artefact can be used. The rationale of the design document was set out by explaining the empirical study that had an influence on the design document. The rationale also described the artefact, why it is being developed, what it does, and who will use it. The rationale forms the background information of the design document. After the rationale, the design and development process that was followed, was discussed. The first step in the design process is to determine the business, functional, and technical requirements. The business function was defined as a business need that should solve a problem or enhance something. The business function in this document was that a tutoring enterprise needs an application to be developed that would automate their tasks that take their employees too long to complete. The functional requirements describe how the business requirement will be met. The technical requirements describe requirements that users did not request but they need to meet the functional requirements. Various requirements that will not be included in the current prototype have also been listed.

Next the graphical user interfaces for all the functional requirements have been designed, and their content was described to show that it will fulfil the requirement. The next part was concerned with the development of the prototype and included topics such as the development software and storage service that was used. The coding standards, naming conventions and programming principles that was adhered to was listed. The last part of the document includes the user guide. Since the artefact is in the prototype phase and a future could see the application be developed, the user guide was set out to act more as a working example of the application use that an instruction manual. The user guide was set up in informal language to ensure that readers understand the instructions and they are not bombarded with jargon. As previously mentioned, the artefact is currently a mobile application prototype and can still contain various errors or gaps, therefore support information was given as part of the user guide. The design document and user manual could drastically change once the mobile application is developed but the information in this document could support the development since a lot of relevant information is already included in this document.

# REFERENCES

Ambler, s. W. 2004. *The object primer: agile model-driven development with uml 2.0*, cambridge university press.

Bell, e., bryman, a. & harley, b. 2018. *Business research methods*, oxford university press.

Collins, b. 2019. 7 reasons why google apps script is a great first programming language to learn. *Learn to code with me* [online]. Available from: https://learntocodewith.me/posts/google-apps-script/#:~:text=google%20apps%20script%20runs%20on,run%20that%20in%20your%20browser. 2020].

Creswell, j. W. & poth, c. N. 2016. *Qualitative inquiry and research design: choosing among five approaches*, sage publications.

Galitz, w. O. 2007. *The essential guide to user interface design: an introduction to gui design principles and techniques*, john wiley & sons.

Garima. 2019. Why business and functional requirements are vital for a project's success. *Net solutions* [online]. Available from: https://www.netsolutions.com/insights/business-and-functional-requirements-what-is-the-difference-and-why-should-you-care/ 2020].

Miller, r. 2019. Glide helps you to build mobile apps from a spreadsheet without coding. *Techcrunch* [online]. Available from: https://techcrunch.com/2019/02/12/glide-helps-you-build-mobile-apps-from-a-spreadsheet-without-coding/ 2020].

Raphael, j. 2020. This amazing tool turns google sheets into slick apps—no coding required. *Fast company* [online]. Available from: https://www.fastcompany.com/90541149/this-amazing-tool-turns-google-sheets-into-slick-apps-no-coding-required 2020].

Saunders, m., lewis, p. & thornhill, a. 2011. Research methods for business students. India. Pearson education.

Vega, k. 2018. Complete guide to the requirements gathering process. *Dpm* [online]. Available from: https://thedigitalprojectmanager.com/requirements-gathering-guide/ 2020].

Wieringa, r. J. 2014. *Design science methodology for information systems and software engineering*, springer.

Zhang, e. 2019. What is role-based access control (rbac)? Examples, benefits, and more. *Datainsider* [online]. Available from: https://digitalguardian.com/blog/what-role-based-access-control-rbac-examples-benefits-and-more#:~:text=the%20roles%20in%20rbac%20refer,%2c%20responsibility%2c%20and%20job%20competency. 2020].